THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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THE PREVENTION OF CORRUPTION.

A BILL has been introduced in both Houses of Parliament entitled "An Act for the Better Prevention of Corruption." The fact that similar measures have appeared and disappeared in previous years does not give hope that the present measure will be as seriously considered as should be the case. We anticipate, however, that this attempt to deal with a very urgent question will become law in some form or other before the close of the present session.

It must not be thought that the gift or receipt of a bribe or secret commission is legal at the present time. Such transactions, although they are outside the pale of the criminal law, are severely dealt with at the hands of civil tribunals. Whole transactions may be set aside if it is found that an agent or servant of one party has been induced by a secret commission to run counter to his employer's interest. But the difficulty in these cases has been, and always will be, to bring home their guilt to the guilty parties. It may have been this difficulty which has brought about delay in declaring criminal what has, hitherto, been included in the category of civil wrongs; and it may be predicated that any legislative measure which deals with this question can be of but small value unless it is drafted in such a way that guilt shall be soon followed by conviction and punishment. Let us consider certain parts of the text of the proposed measure.

Reading it very shortly, the first paragraph of the first clause of the Bill provides that "If any agent corruptly accepts or obtains, or attempts to obtain, from any person any gift as an inducement for doing any act in relation to his principal's affairs, or for showing favour to any person in relation to his principal's affairs or business, he shall be guilty of a misdemeanour."

Did this provision (or rather the provision of which this is an abstract) stand alone, we could imagine nothing better calculated to effect the desired object. Suppose, for instance, the case of a traveller seeking orders for his firm. He approaches the manager, or engineer, of a company, with a view to obtaining such orders. The manager (acting as agent for the company) makes it plain that unless some commission or percentage is forthcoming, the traveller will get no orders. Rather than lose the orders, the traveller puts his hand in his pocket; and it may be that his firm not only know that he does so, but authorise him to pay the bribe. In the result the price of the goods to the company is either directly or indirectly increased by the amount of the commission which finds its way into the manager's private banking account.

Pausing here, we are at once met with the very natural retort that he who offers and pays a bribe is *particeps criminis* with the man who receives it. If there were no bribers, there would be no bribed; and it is difficult to see how the Legislature can avoid making recognition of this

fact. At the same time, there are cogent reasons why the person who merely offers and pays a bribe should be dealt with on a different footing.

He who offers is the person interested in securing the contract. To him it is a mere matter of business. If he is a traveller, he has probably been told to get business at all costs, and the employer is but too glad to foot the bill for commission. Furthermore, it is no offence under the criminal law to tempt a person to steal. To leave your front door open and your money lying about may be foolish; to hang goods outside a shop in such a position that they can easily be stolen may be to court the attention of thieves; but it falls far short of crime.

The Bill under notice recognises that the giver and receiver must be equally punished, for the second paragraph of the first clause provides that "If any person corruptly gives or offers any gift to any agent as an inducement for doing or, for having to do, any act in relation to his principal's affairs, or for showing favour to any person in relation to his principal's affairs, he shall be guilty of a misdemeanour." This clause, if it stood alone, would enable the person who offered and gave a bribe to be convicted upon the information of the person whom he sought to influence.

It is clear, however, that if the two clauses above considered are to become law in their present form, to prove the receipt or gift of a secret commission will be a matter of the greatest difficulty. How will it ever be possible to secure a conviction? What agent is going to give evidence that he has given a commission when the disclosure must inevitably work his own undoing. The very statement which he makes before the magistrate could be used against him to show that, although the person whom he accuses was guilty of an offence under Clause 1 (above), he himself is guilty under Clause 2. In our view it will be impossible to secure the conviction of the receiver of a secret commission unless some degree of immunity is accorded either to the person who pays the bribe, or to the person who receives it. These transactions are not carried on in the light of day. It is a comparatively simple matter to make a payment in hard cash, and so to adjust accounts and statements of account that there shall be no trace of surreptitious dealing, unless evidence from within is forthcoming.

Doubtless there are grave objections to allowing the person who offers or pays a secret commission to escape scot free. To do this may be to open the door to blackmail. Again, it may be urged in favour of the retention of both clauses that they will have a moral effect, that whereas the payment or receipt of a bribe is not now a criminal offence, the fact of making it an offence will tend to make people honest. It is hoped that this may prove to be the case.

While there is much that is futile amongst the clauses of this measure, there is one point which must not be overlooked. It is made an offence to *offer*, or to attempt to obtain, a commission. It will, therefore, be competent for an honest agent who is alive to the protection of his principal's interests, to set the law in motion against any person who attempts to bribe him from the path of duty; or for a traveller or other agent to bring to justice any person who attempts to obtain a secret commission. It will be interesting to see whether any information will be laid charging any person with the offence of offering a bribe.

There is every reason to hope that in this respect the new measure may prove to be of great value. Where he knows the man with whom he is dealing, a person who is acting contrary to his employer's interest may venture to solicit a secret commission; but unless he has this knowledge, his solicitation may involve the preferment of a charge under the Act.

If those who are the victims of bribery and corruption were to hold together, it is anticipated that the measure under discussion might be used as a most efficient weapon for the suppression of bribery. Suppose, for instance, a householder were to take a house in a new neighbourhood, and a tradesman were to offer to the householder's butler a commission of 5 per cent. on all orders which reached him from that house. This offer would be an offence under the Act. If all tradesmen in the district who offered bribes were treated in a similar fashion, the practice of making these offers would soon cease.

We fully appreciate that the Bill is open to the grave objection that there is but little hope of bringing home conviction to a person who actually receives a commission. Nevertheless, it will be competent for those who are so often bled for secret commissions to lay an information against any person who solicits a favour of this kind.

The Electrobus.

In our "City" pages to-day, and also in our "Notes" columns, we are again dealing with the promotion of this scheme, which, since our last issue, has been placed before the public. Since the appearance of the prospectus, the scheme has been severely criticised in the daily Press.

Cost of Electricity from Private Plants.

The discussion on Mr. Hartnell's paper, of which an abstract is given elsewhere in this issue, was of a strongly controversial character, and as Mr. Campbell judicially observed, the truth probably lies somewhere between the extremes quoted. We are not concerned here to join in the controversy on behalf of either party, but we cannot help commenting on the mental attitude of some of the speakers. It is not only true, as Mr. Emmott stated, that in many cases no allowance is made for coal and maintenance charges on engines and boilers pressed into the service of electricity supply, but there are serious supporters of this mode of computation. Interest and depreciation on the proportion of cost of buildings and plant are also often omitted.

Taking the coal question first, we are assured that a 42-H.P. engine driving a dynamo for lighting a woollen mill made no difference in the coal consumption, the inference being that it used no steam. The more reasonable inference, to our mind, is that the management of the mill was at fault, and that the coal bill was probably burdened with a large proportion of waste expenditure—but that is not a reason for acquitting the electrical plant of an appetite for steam. If steam really costs nothing at these works, the proprietor will clearly be well advised if he offers to supply it to his neighbours at a phenomenally low price. We are even informed that the effect of increasing the load of an engine, so as to bring it up to a more economical working load, does not necessarily increase the consumption of coal!

Mr. Hartnell himself put forward the suggestion that where the increased cost of extra light was scarcely noticed, the lamps were allowed to glow without stint; obviously, kilowatt-hours thus uselessly consumed must be deducted from the total before any comparison is made with the cost of lighting from public supply mains. As he pointed out, his paper was not written to institute comparisons of this kind, but, nevertheless, it practically challenged such comparisons.

The fact that the working costs of electricity works and those of private plants are not directly comparable with one another was clearly shown in the discussion. The importance of the capital charges, so often emphasised, was also demonstrated. What was not so prominently shown, though it was hinted at, was the fact, of fundamental importance, that by hiring motors and taking energy from a supply authority, a user of power is able to devote his spare capital to his business and to earn 10 or 15 per cent. upon it, or even more. This fact entails the corollary, also important, that the interest calculated upon the capital cost of dynamos, engines,

boilers, &c., should be assessed at the same rate as the proprietor's return from the capital invested in his manufactory—not 5, but 10 or 15 per cent. This is not a question of opinion, but of fact; and we know of manufacturers who have realised it, and have turned it to good account.

Deep Sea Research.

A very interesting paper by Dr. James M. Flint has recently been published as *Bulletin No.* 55 of the United States National Museum, which deals with the large number of 2,074 soundings taken in the Pacific ocean for the survey of the route for the telegraph cables between the Sandwich Islands and the Philippines and Japan, by way of Midway Island and Guam, the line between San Francisco and Honolulu having been sounded with satisfactory results previously. In the earlier part of 1899, the U.S.S. *Nero*, a steam collier of about 5,000 tons, was fitted out for the work and sailed from San Francisco under the command of the veteran Captain Belknap, who so far back as 1874 had already greatly distinguished himself in this work. Unfortunately on the ship reaching Manila, Capt. Belknap was seized with illness and had to resign his command to Lieut.-Commander H. M. Hodges.

The total length of the line surveyed was 6,000 miles, and the soundings were zigzaged over a belt 14 miles wide, while complete surface and bottom temperatures were also taken. One of the most interesting results obtained was the discovery of a submerged range of mountains about half-way between the Marianne or Ladrone Islands and Midway Island, which rise from a fairly level plain 3,000 fathoms below the surface to within 700 fathoms in places, and extend over some 200 miles of longitude. To the eastward of Guam very irregular bottom was found, the depths varying from 5,000 and upwards to under 700 fathoms. An abyss, subsequently called "Nero Deep," was struck about 75 miles E.S.E. of Guam, in which soundings of 5,070, 5,101, 5,160 and 5,269 fathoms were taken. The last-named is claimed as the greatest depth ever discovered. Its exact position is given as lat. 12° 43·3 N., long. 145° 19 E.* Between the Marianne or Ladrone Islands and Japan, a continuous line of mountains was found connecting these Islands with the Bonin group.

The Cable Co. who own the important cables subsequently laid over this well explored ground, are to be congratulated on the valuable help given them by the United States Government, and on the fact that it was entrusted to the skilled hands of Captain Belknap. It is difficult to overestimate the importance of placing at the head of such investigations an officer of special merit, whose knowledge of the work makes its execution a matter of absorbing interest, instead of a dull monotonous performance as it is too likely to be in the hands of the ordinary sailor, with, it is needless to say, a loss of efficiency.

Americanese.

Mr. Churton Collins has been expostulating in the correspondence columns of the *Times* against the use of the word "electrocute" and its derivatives. He calls them barbarous, and nobody can deny that they savour strongly of the fervent young American reporter who cultivates, or at least practises, the illegitimate art of coining base words. Perhaps the easy acceptance of many of these words can be attributed justly to our increasing neglect of the dead languages from which most of our modern languages have sprung, and half a century hence the compilation of an etymological dictionary will be a hopeless task for the greatest scholar. Meanwhile, let us not as a profession give too much countenance to the use of impure new words which may defile our language for ever. There are a vast number of such already in common use, and it is quite possible that many are euphonious enough, but that is no reason for adding more when a little timely academic advice could add purity to euphony.

In the particular instance cited above, Mr. Collins considers that "electricide," both as noun and verb, is the correct form, and he upholds this view ably in a second letter in the *Times* of April 21st. Perhaps some of our classically nurtured readers will have something to say on the point. Our own opinion is simply that no special word is needed at all. People have been scalded to death by escaping steam, suffocated by gas, and in other ways accidentally killed, for quite a long time past, yet no one, we believe, has taken the trouble to coin new words to denote these meanings. Why, then, should the plain expression "kill by electricity" be superseded? It may not be technically accurate, but it is comprehensible, and certainly it is infinitely preferable to "electrocute"—which essentially means, and has always meant, to execute by electricity in expiation of the crime of murder. "Electrocute" was derived (!) from the expression "execute by electricity"—a fitting association for this murder of the Queen's English.

The Trades Disputes Bill.

Signs are not wanting that the Government of the day purpose to carry out their avowed intention of dropping the Trades Disputes Bill, which was introduced by the Attorney-General, and supporting that which the Labour Party have pledged themselves to carry through. It appears, however, that the pilotage of the Bill in the House of Commons is to be entrusted to the Solicitor-General (Mr. Robson, K.C.), who, as an old supporter of the Labour Party, will have no difficulty in reconciling his legal conscience to the grant of immunity to the trades unions. The Attorney-General, it appears, is not equal to the task. Indeed, it is difficult to see how he could have undertaken it, after he had pointed out, in the course of a speech which lasted for more than an hour, the unwisdom of "creating privileges for the proletariat." In the controversy which has arisen since the Bills were introduced, two arguments in favour of the principle of total immunity are continually advanced. It is said (*a*) that inasmuch as for 30 years prior to the Taff Vale decision the unions were totally immune from actions at law (and this without any apparent hardship to employers), there is nothing new or dangerous in the principle of immunity; (*b*) that a trade union is never fairly treated by a British jury, or, in other words, that their cause is submitted to an unfriendly tribunal. It is not difficult to expose the fallacy of both these arguments. With regard to (*a*), it is clear to the meanest intelligence that the Labour Party are asking for much more than the mere reversal of the Taff Vale decision. They are asking that picketing shall be legalised, and that the law of conspiracy shall be amended in their favour, so as to authorise tyranny, boycotting and coercion. Prior to the Taff Vale case, members of trade unions were liable to actions for nuisance or for conspiracy in their individual capacities. They now ask to be relieved of the duties which are imposed upon all others of His Majesty's subjects.

As to (*b*)—the allegation that juries are prejudiced against the unions—would they prefer to have their cases submitted to a judge without a jury? The cry would then be that the judges were prejudiced against them. It is a common complaint that the sympathies of a jury are with the weak and the oppressed. Who shall say that a jury, whose sympathy is with the plaintiff in an action brought against a railway company, is incompetent to decide between a trade union and the workman who, through the action of the union, is thrown out of employment? Of course, it may be said that as between employers and trade unions, there is likely to be prejudice in favour of the employers; but the possibility of injustice arising from this cause is not, to our mind, nearly so grave as the certainty of injustice if total immunity were conceded to the Unions.

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* The previous "record" was 5,155 fathoms about 550 miles N.W. of New Zealand, found by H.M.S. *Penguin*, 1896. Other great depths are 4,655 fathoms off Japan, U.S.S. *Tuscarora*; 4,575 fathoms E. of Philippines, H.M.S. *Challenger*; 4,561 fathoms N. of Porto Rico, U.S.S. *Blake*. The mention of 9,000 metres (4,920 fathoms) in our last issue, as the greatest depth ever sounded, was an error.

INDUSTRIAL REDISTRIBUTION.

[The Development of the North-Eastern Districts.]

The ever-increasing rating burdens which manufacturers are called upon to carry, and the onerous requirements imposed upon them in the design and erection of their works, particularly in the area of the London County Council, are prominent among the serious difficulties that confront industrial concerns to-day. Unfortunately, there has been such an accumulation of evidence proving the seriousness of the position which has been in this way created, and is becoming every year more and more aggravated, that it is needless after all that has had to be published on the subject, to enter into a detailed enumeration of examples. The existence of the evil being commonly recognised, and there being no immediate prospect that either partial or substantial relief will be meted out, there has naturally forced itself upon the attention of some industrial leaders the necessity of finding a remedy which shall ensure the survival of their undertakings—now threatened—and at the same time enable them to be equal with their competitors in the race and make more reasonable return upon their capital than has been the case in recent years.

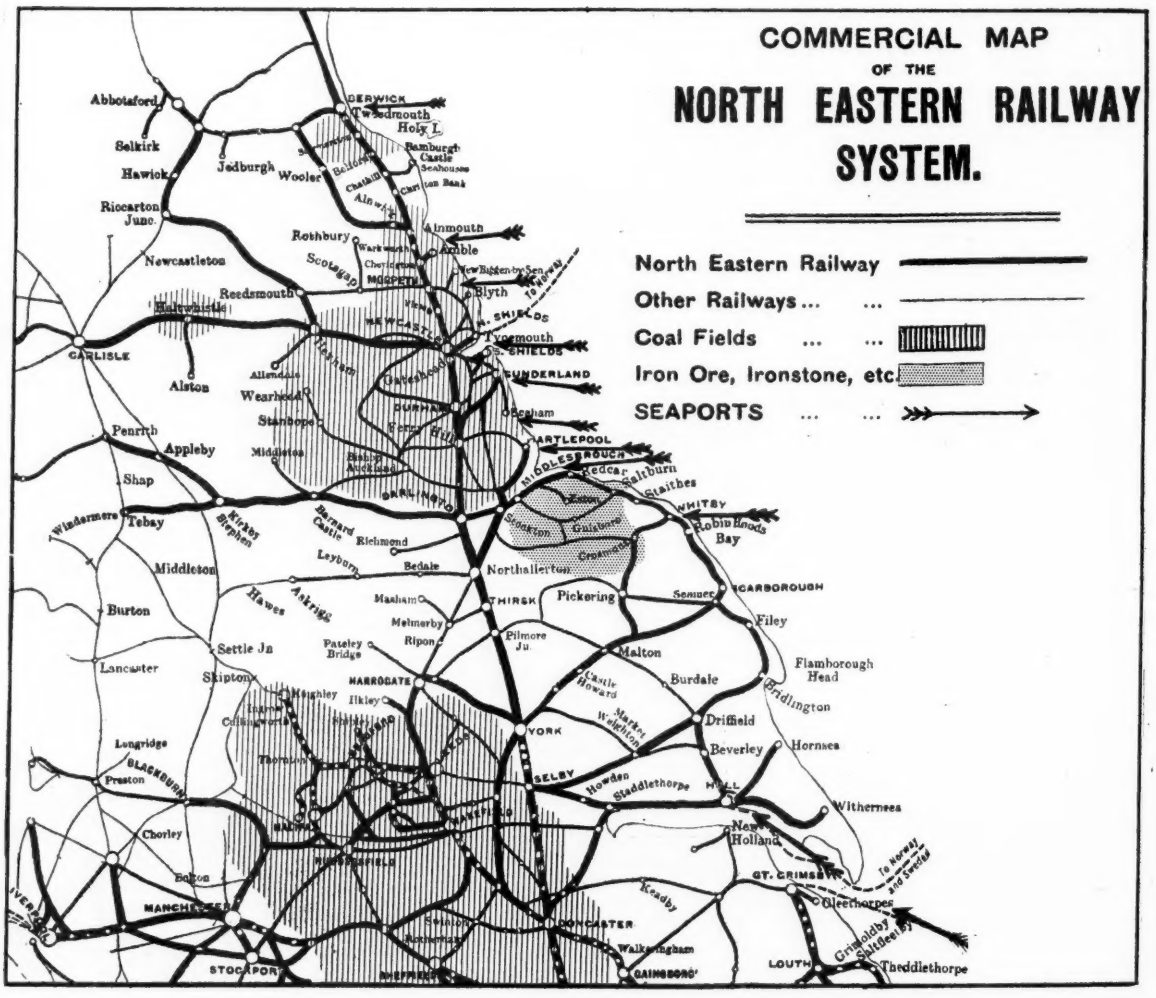
We have all witnessed during the last decade the migration of eminent engineering firms from the metropolitan area to the provinces, and there is every reason to believe that there is going to be a good deal more of this sort of thing before long.

This being the position of the matter at the moment, we think it will be well to bring to the notice of the electrical and other engineering trades—whether in or about London or any other districts where such difficulties as we have alluded to prevail—an important industrial development scheme which is being energetically conducted in the very large area through which the North-Eastern Railway system runs. In the districts where electric power supply is cheaply and plentifully available, there is to be a valuable co-operation between the electric supply companies and other local authorities in furthering the Railway Co.'s scheme. The already carefully nursed Tyneside district is one that is ripe for new industries, and the decision of the Castner-Kellner Co. to set up additional works there is fresh in the minds of our readers. The Newcastle-upon-Tyne Electric Supply Co., Ltd., and the County of Durham Electric Power Distribution Co., Ltd., in particular, are co-operating whole-heartedly with the railway company.

In a word, the main object of those concerned in this industrial activity development scheme is to establish new industries where rates are low and electric power is cheap, and where railway and water facilities are abundant.

We understand that the matter is being treated on the broadest possible basis, and the North-Eastern directors have placed at the helm to direct the course of this very important undertaking, Mr. E. C. Geddes, who, as "Commercial Agent," has his headquarters at York. This gentleman is, by reason of his exceptional experience in matters of this kind, as capable a man as it would have been possible to find for the responsible duties that are already falling upon this new department.

Below we discuss the matter in further detail, and we venture to believe that when the manufacturing and directing class of our readers who are interested in works now located in large centres, have read our remarks, they will find it well worth their while to place themselves in touch with Mr. Geddes's department, so that he may place at their disposal that large fund of information concerning the localities, &c., which he has accumulated and filed ready for reference.



The scope of Mr. Geddes's post as commercial agent, is of the very widest, and comprises the taking of measures to encourage the development of the North-Eastern Railway territory agriculturally or industrially, and *inter alia* these objects have received consideration. The agricultural side of the question will not interest our readers directly to any great extent, although dairies and allied undertakings may make some use of electrical power—this is already the case in more than one instance in the company's territory.

Undoubtedly, if the scheme proves to be the right means for bringing about the redistribution of factories, a great national work is being forwarded, and it is conceivable that it may be of considerable assistance in remedying some of the burning questions of the day, such as the unemployed question, the physical deterioration question, and also the commercial supremacy of British manufacturing. High rating, high land rent, the difficulty of housing, the cost of carting raw materials and manufactured products to and from the rail, are all potent forces against manufacturing at a profit in our largest cities. In addition to these, we might also consider the effect upon the operatives of residence in a large area like London. Much of their energy, and to some extent their earnings, are taken up in travelling to and from their work.

The present-day facilities of transportation, and the enormous advantages to be derived from cheap electrical power, render it no longer necessary for manufacturing to be carried on in a large town, and it is contended that providing the manufacturer is well represented by salesmen, he can with great advantage to his business carry on his work away from the town, or at any rate in one of the provincial towns where he will be practically immune from the serious disadvantages already named.

For the purpose of effectually dealing with the matter, it has been necessary first to ascertain and tabulate what the country has to offer; naturally this entails an enormous amount of work in a territory covering, as the North-Eastern Railway does, some 7,000 to 8,000 square miles. The resources of the line have been collected and arranged in such a manner that in the new department it can be demonstrated clearly to an inquirer just what alternative places upon the line are correctly situated from an economic and geographical point of view for the particular industry which he contemplates establishing. Information as to climate, sub-soil, labour, housing, rating, land and innumerable other subjects, all of which are potent factors in enabling a would-be manufacturer to come to a decision, are collected, tabulated, and kept up to date.

The manufacturer is generally an expert in his own business, but good must result from a collaboration of his specific experience and the general experience which must be acquired by an office such as we have described.

There is one other side to the question which possibly will not strike the casual considerer. In the past, when a would-be manufacturer, large or small, has approached a railway company on the subject of the establishment of an industry, he has found that he has to deal individually with the innumerable departments which constitute the railway organisation. The new office, however, is, in fact, a bureau of facilities which collects for the would-be manufacturer all the information he requires as to rates, siding questions, train service, land questions, &c. This providing of facilities not only applies to the various departments of the railway, but applies also to the various dominant interests in the part of the country to which he wishes to go. In fact, the Commercial Agency of the North-Eastern Railway is prepared to supply all the information which a would-be manufacturer requires, and is prepared also to put him in touch directly, and, where possible, by personal introduction, with the right men in any particular locality to help him in his enterprise and to welcome him to their community.

We publish the commercial map appearing on the previous page for the interest of our readers as a whole. It shows the big section of country covered by the scheme. We may remark that the Newcastle-upon-Tyne Electric Supply Co. cover a very large area to the north and south of Newcastle, and the cheapness of electric power there needs no telling at this date. Their area is in the centre of a coalfield, and we understand that labour, both male and female, is plentiful, land is cheap, the death rate low, and railway communication ample.

In the area of the N.E. Co. there are of course other supply authorities, among them the Cleveland and Durham County Electric Power Co., the Northern Counties Electricity Supply Co., Ltd., and the Yorkshire Electric Power Co., whose generating station is at Thornhill. There are also several other minor private and municipal electricity supply undertakings, for practically all the principal towns in the North have their own electrical power generating stations.

No doubt explicit information will be asked for on the subject of rating. This, of course, varies very considerably, but there are districts in the area where the rates are as low as 2s. 4d. in the £, and where conditions are in every way favourable for industrial development. Districts within the rateable boundaries of the larger towns are more heavily rated, but the very highest figures amongst these compare very favourably with the rates obtaining in the industrial portions of London. The minimum and maximum figures for districts favourably situated for industrial development may be put at from 2s. 4d. to 7s. 6d. in the £. The first named figure, we are given to understand, need not be regarded as exceptional.

Then on the point of wages it will be understood that, as the North-Eastern Railway covers such a wide area, the rate varies very considerably. In the industrial districts the average rate may be put at 30s. to 37s. per week for skilled labour, and 18s. to 25s. per week for unskilled. There is a good deal of piecework done in the North of England, and an average weekly rate of money earned for this class of labour is difficult to fix. In the agricultural districts the average rate is 18s. to 19s. for unskilled, and 24s. to 25s. for skilled labour.

In conclusion, we may add that though papers have been written and read before societies and institutions, dealing with industrial redistribution of factories, the present movement is the first, we believe, to set these theories into practical operation.

STEAM PIPE INSPECTION.

Steam pipes formed no part of the earliest schemes of the steam engineer, for the whole engine was on the top of the boiler, and the steam pipe was too short or embryonic to merit a distinctive name.

The pipe became necessary when the engine was placed on its own foundation, thus relieving the steam boiler of its duty as a foundation for the engine, and placing it the one step forward out of the four steps necessary to its full evolution as a boiler. The other duties left to the boiler were feed purification, feed heating, and, in time, superheating.

Superheating is now generally recognised as an operation to be carried out in a separate vessel, but feed purification and feed heating are still done in the boiler in even London's latest power and lighting stations.

So, too, with steam pipes, having become distinct entities, they ought to be considered as such, whereas they have too frequently been left to be put together merely as a means of connecting an engine to a boiler, and no thought has been expended on their design as carriers of steam. Yet some of the worst accidents to steam plants have been caused by improper steam piping, and to this day one may see valves placed so as to trap water and produce water hammer, bends which do the same, stresses due to lack of provision for expansion, cheap and badly put together materials, which led to that ridiculous scheme of ring mains and excessive duplication, as though the duplication of two dangerous things could make for safety.

In the *Vulcan*, which is the organ of the Vulcan Boiler Insurance Co., an article appears on the Inspection and Insurance of Steam Pipes, a subject to which a painful publicity has been given by the recent bursting of the valve body of a turbine at Bright Bros.' factory at Rochdale, as well as by the bursting of a steam pipe at Dundee, in January, at the works of David Smith & Sons. It is urged that the number of accidents to valves and steam pipes might be very much reduced if steam users would place their pipes under the boiler insurance companies for inspection and insurance. Some firms already do this. The inspection of pipes by an expert would in time conduce to better practice, just as inspection has done so much for boilers. Prior to the days of boiler inspection, all manner of accidents happened to steam boilers which were regarded as accidents. But when a number of men inspecting boilers all over the country, and sending in sketches of boilers and settings, began to report the same thing, and various minor accidents began to accumulate as evidence before the staff in the head office, it soon

became apparent that a particular form of corrosion was most severe with certain peculiarities of construction, and that certain arrangements of blow-out pipe accompanied fracture of that detail. Such repeated coincidences could not fail to draw attention to the relation of cause and effect, and once the cause was discovered, the remedy could be more or less thoroughly applied. Experimental knowledge in time could be supplemented by deductive reasoning, and progress in improvements was made more rapid as evidence of the principles involved accumulated. Too frequently the steam piping is carried out by neither the engine-builder nor the boiler-maker, and it is surprising how many faults may be found in a single length of pipe. Thus the modern station man is very particular to employ mild steel for his pipes, but he gaily employs cast-iron valves to join different lengths though valves are now made with their bodies pressed out of mild steel plate. Main steam pipes are still to be seen much too close to the stop valves on boilers, when there ought to be a long branch between to give elasticity, and it is no unusual thing for the branch to rise above the junction or stop valve instead of the stop valve being at the highest point.

In laying out a design for a steam pipe, the designer should consider the finished design, specially in reference to every possible place where water can lodge, and the effect of a body of water when steam is admitted, for this may produce water hammer.

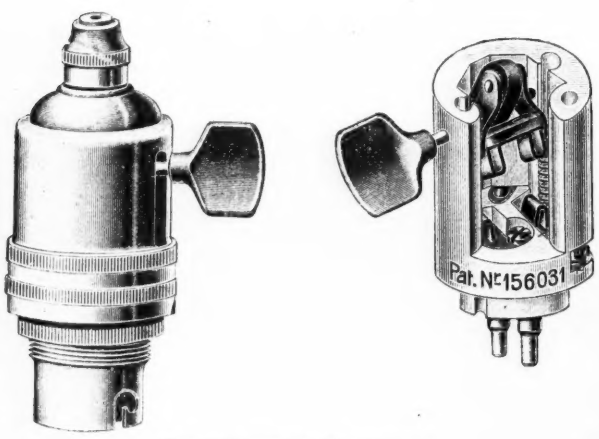
Expansion bends are necessary to give elasticity, but that is no reason for making them so that they serve as water traps. The Dundee explosion referred to above showed up the fact that one side of the pipe was $\frac{7}{8}$ in. thick, the other only $\frac{1}{2}$ in., but what can one expect from a cast-iron pipe, especially if cast horizontally? Then there is the brazed copper pipe wholly unfit for modern pressures or for superheat.

The plea of the *Vulcan* that pipes should be inspected as carefully as boilers seems to be well founded. We fear that the reports on many schemes of piping of no great age would not prove very flattering to their designers.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

The "Emitevas" High-Voltage Key-holder.

This device has been introduced to meet the need for a key-holder so constructed as regards length of break, quickness of break, insulation and carrying capacity of the metal parts, as to be thoroughly suitable and reliable for high-voltage supply. The "Emitevas" holder has been constructed with a quick $\frac{3}{8}$ in. break, and



The "Emitevas" Key-Holder.

with contact pieces $\frac{7}{16}$ in. apart and separated by a porcelain bridge, in order to meet these requirements, and it is claimed to be particularly simple in construction, and to give ready facility for wiring. It may be obtained from any of the suppliers of electrical fittings and accessories, or of The "Emitevas" Electrical Fittings Co., St. Pancras Goods Station, Midland Railway, N.W., or wholesale only from Messrs. J. & H. Grevener, Eldon House, Eldon Street, London, E.C.

Portable Ozone Generator.

We recently inspected a new machine which has been introduced by Messrs. Ozonair, Ltd., for use in living rooms, offices, &c., where the ordinary generators which they make would be unnecessarily large. The machine is energised by a small portable accumulator or primary battery, with which it is connected by flexible cord and a plug, and is thus independent of public supply mains. Its construction is generally similar to that of the large portable generators, and includes an ozonising chamber, electrically driven fan, coil, switches, &c., handsomely finished and fitted into a neat polished walnut case. For medical and surgical purposes a flexible tube with mouthpiece and directing nozzle is provided, if desired. The whole thing measures 11½ in. × 8 in. × 8 in., and weighs 10 lb., while the power taken is stated to be but a few watts. We understand that the machine has already attained popularity, and that a set submitted to the Institute of Hygiene has received the certificate of that body, and has been placed on exhibition in the Institute.

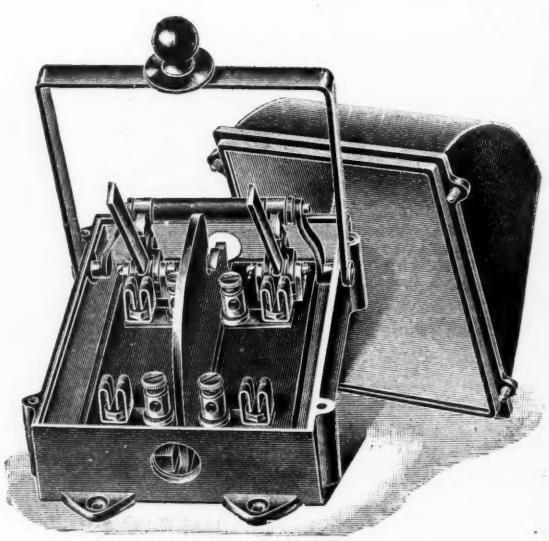
The company is busily prosecuting researches and carrying out experiments in both the construction of generators and the

Portable Ozone Generator.

utilisation of the ozone, and we are informed that greatly improved results have been obtained. The output of a machine taking 200 watts is given as 700 gm. per kw.-hour, at a concentration of 12 parts in a million, and 130 gm. per kw.-hour, at a concentration of 330 parts in a million.

Ironclad Switch.

Messrs. Rumney & Rumney, of Victoria Street, S.W., have sent us advance copies of their illustrated price lists of main and sub-circuit switches, enclosed fuses, &c. Their latest pattern of watertight ironclad knife switch is shown in the accompanying



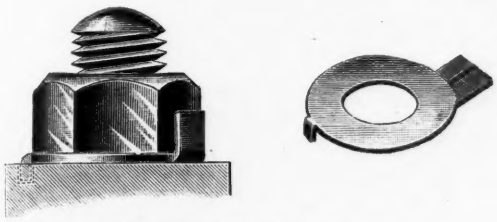
Rumney Ironclad Knife Switch.

figure. These can be made in any size from 10 amperes upwards, and are specially suited for high voltage circuits; indeed we understand that all Messrs. Rumney's high-tension switches, &c., are made in accordance with the Glasgow Corporation Rules.

The Positive Locking Washer.

The Positive Locking Washer Co., 20, York Grove, Queen's Road, S.E., has issued a circular describing, and giving prices of, the Positive locking washer, which is claimed to be an efficient and economical method of securing bolt nuts and set screws where

great vibration is in force, especially for motors, tramways and railways; it is said to obviate the present method of lock nuts, castle nuts and cotter pins. It is used like the ordinary washer, with the exception that an indentation is made in the work with a



The Positive Locking Washer.

breast-drill or punch to take the nib; the nut or bolt is tightened, and the lap is struck into position, so forming a firm grip. The lap is grooved or channelled on one side radially of the washer, in order that the necessary adjustment of the nut may be made.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"Electra" writes:—"A person who resides in another parish, about 30 yds. beyond the area of supply of the local company, is desirous of taking a supply of electricity. It would not pay the company to obtain a provisional order for this district. It is possible to take a supply by passing on private ground. Would it be legal for the company to do this, and would the consumer incur any liabilities?"

*** It is presumed that the local company is at present supplying electricity in accordance with the terms of some provisional order. This being the case, it must be subject to the provisions of the Electric Lighting (Clauses) Act, 1899, or a provisional order which contains provisions similar to those which are to be found in the schedule to that Act. It is there provided by Sec. 4 (2) that the undertakers shall not at any time after the commencement of the special order supply energy or (except for the purposes of that order) erect or lay down any electric lines or works beyond the area of supply, otherwise than under the authority of Parliament, or under a licence granted by the Board of Trade under the principal Act. If the undertakers supply energy, or erect or lay down electric lines or works in contravention of this section, the Board may, if they think fit, revoke the special order on such terms as they think just. The fact that the supply can be given over private ground does not appear to affect the question. It is conceived that in these circumstances, the consumer referred to by "Electra" cannot obtain a supply from the company in question.

"X.Y.Z." writes:—"I should like to know under what Act the consumer can be prosecuted for breaking the seals of prepayment meters."

*** There is no statute which deals expressly with prepayment meters, but it is provided by Sec. 38 of the Gasworks Clauses Act, 1871 (34 and 35 Vict. c. 41), that every person who wilfully, fraudently or by culpable negligence injures or suffers to be injured any . . . . . meter . . . . . belonging to the undertakers, or alters the index to any meter, or prevents any meter from duly registering the quantity of electricity supplied, or fraudulently abstracts, consumes or uses electricity of the undertakers, shall (without prejudice to any other right or remedy for the protection of the undertakers or the punishment of the offender), for every offence forfeit and pay to the undertakers a sum not exceeding £5. Further, in case any person has injured or suffered to be injured any meter, or altered the index of any meter, or prevented the meter from duly registering, the undertakers may, until the matter complained of has been remedied, but no longer, discontinue the supply of gas to the person so offending. It is apprehended that although no specific mention is made of prepayment meters in this Section they are affected by its provisions.

German Electrical Imports and Exports.—A marked increase has taken place so far this year in the exportation of electrical machinery from Germany, the shipments during the two months ending with February last, having reached a total of 3,569 tons, as compared with only 2,210 tons in the corresponding period of last year. There has also been an increase in the imports of foreign electrical machinery into Germany—from 174 tons in the first two months of 1905 to 292 tons in the two months ending with February last.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Discourtesy to Candidates.

There has been lately, and is periodically, a discussion in your columns on the behaviour of municipal and other electrical committees towards candidates for whom they advertise.

Why is it that an applicant is allowed to wait in suspense week after week and never receive any direct intimation of his want of success? Is it an extraordinary, and in other directions invisible, love for economy? Is it sheer callousness and brutality, or is it an absolute lack of civilised manners?

In your "Personal Column" this week you report the appointment by the L.C.C. of three charge engineers to the Greenwich station. I am one of the candidates and have had no communication from the Council since my application was sent in. The rest are probably as well off.

I applied in answer to advertisements in your columns for chief engineers at Aldershot and Dartford and other places which slip my memory. You may remember how long ago this must have been, and the only notices I have had as to whether the appointments have yet been made were your reports accidentally seen while glancing through the Review. Surely, anyone who aspires to such a position should be treated with as much consideration as a casual labourer who is told when no more hands are wanted.

Some Councils have the courtesy to send their thanks if not regrets, and their management costs per unit are not noticeably higher than, say, Dartford or Aldershot.

A Lover of Civility.

Preferential Rates?

Can you, or any of your readers, inform us through the medium of your columns, if you or they are aware of any of the leading electric incandescent lamp manufacturers quoting supply corporations better terms for the same quantity of lamps, viz., 5,000 and 10,000 lots, than they do to merchants or contractors?

Brig.

A Buyers' Guide Wanted.

I have no doubt that many of your readers are closely interested in the supply of small stampings and small turned parts and accessory fittings generally, and the writer would be glad to know the experience of draughtsmen in obtaining prices and delivery of such appliances. My patience is almost exhausted in trying to obtain courteously prompt and reasonable attention even to inquiries, and it seems to be hopeless to get anything like reasonable delivery. My experience is that it takes weeks to weed out firms who pose as manufacturers, and write "our works are going carefully into your recent inquiry, and we will write you again in the course of a post or two." A little calculation brings out the facts in such instances, as it takes two days to mail the Continent, and, say, three days to work out prices, and two days return mail from, possibly, the happy Fatherland. I deplore the waste of time which this manœuvring occasions; the root of the evil certainly lies in the utterly superfluous entries under trade headings in many directories, and the laxity evident amongst manufacturers in advertising in trade journals. It is obvious that it would not pay small middlemen to advertise such specialities, but on the other hand, the expense under a trade heading is *nil*, and exactly meets their requirements. Perhaps a number of your readers resident in various parts of the country could assist in the work of compiling the matter for a "Buyers' Guide," which might easily embrace each department of the trade, in which entries would not be charged for, but which directory might be purchased at a price within the reach of all interested parties. This could easily be kept up to date by supplement (as is the telephone directory) by resident representatives, who could report the exact nature of work undertaken by all

firms existing, or cropping up, in their locality. I would like to know if my experience is shared by many of your readers, and whether my suggested remedy is practicable.

Pro Bono Publico.

The R. Kaye Gray Portrait.

I cannot quite agree with Mr. Patchell's letter *re* above in your last issue of to-day. As an Associate Member, I can assure him I did *not* receive any invitation to contribute, otherwise I should have been pleased to do so. The report of the presentation was the first intimation I received, and that was through your columns.

Sidney Rentell.

London, N., *April 20th*, 1906.

The Electrobus—A Disclaimer.

As the manufacturer and patentee of the only electrical accumulator known in the electrical industry as the Oppermann battery, I must disclaim any connection whatsoever with the recent statements made relating to a certain battery in connection with the Electrobus Co., Ltd., now before the public. Such statements are calculated to lead the public to believe that the Oppermann battery mentioned in reference to that company is the Oppermann battery manufactured and patented by me.

Carl Oppermann.

London, N.W., *April 23rd*, 1906.

Neutralised Repulsion Motor.

I must apologise for an incorrect statement made by me in my letter of April 7th, referring to the above subject. I should like to mention, not as an extenuating circumstance, but as an explanation, that my mistake arose out of my too ready acceptance as correct of a description of the motor I showed in my fig. 1, which appeared in 1904 in the *E.T.Z.* over a well-known signature. In the course of an attempt to classify alternate current motors rationally, I was led also to consider the motor in question more carefully, and came to the conclusion that if it deserved a name at all, it should be classed as a shunt machine combined with a reducing transformer.

Reverting to fig. 1 of my letter, the coil, E, produces the transformer field which serves as motor field, and lags 90° behind the E.M.F. (E_1) impressed on E. The E.M.F. (E_2) induced by that field in B, and which is impressed on the armature, will be practically opposite in phase to E_1, and will consequently be in quadrature with the motor field. The motor field and E_2 will be practically constant as long as E_1 is constant. If the self-induction of the armature is entirely eliminated, then the current through the armature will be in phase with E_2, therefore in quadrature with the motor field, and there will be no torque. The neutralising winding, N, is detrimental, since it reduces the armature self-induction (this winding was not shown in the motor which led me astray). The output for weight of such a machine will be very small indeed. As I have pointed out elsewhere, and as I believe is now well understood, it is necessary, in order to obtain a good shunt motor, that, amongst other things, the E.M.F.'s impressed on the field winding, and on the armature winding, respectively, should be in quadrature, and not of the same or opposite phase. The speed of the machine shown in my fig. 1 will not be at all constant under load (even if N is removed); in fact, it is not a commercially useful combination; its torque is either nil, or its power factor extremely small.

Now, in Mr. Cramp's motor, the voltage at the terminals of the armature decreases, and the field strength increases with increasing load, because with increasing current in B more and more of the flux due to E takes its way directly through the armature. The speed of his motor will vary with the load to a greater extent than that of the motor shown by me. As long as the neutralising winding in Mr. Cramp's motor is retained, the output will be almost nil for the reasons I have already stated with reference to my fig. 1, and also because the voltage at the armature terminals decreases with increasing load. If that neutralising winding is removed, the output will rise a little, and the power factor will fall off very much.

Val. A. Fynn.

London, S.E., *April 21st*, 1906.

My attention has just been drawn to Mr. Fynn's letter on p. 592 of your issue of April 13th, and I hasten to answer the questions he has raised. The classification which I used in the discussion referred to is, I admit, faulty; but it has been used, in the main, by most writers, among others S. P. Thompson and C. P. Steinmetz. This is my only excuse for adopting it. I am quite willing to admit that the terms are unfortunate, and lead to curious results, as, for instance, the case cited by Mr. Fynn, in which the term "neutralised repulsion" (though correct in my sense) is certainly not satisfactory.

I welcome Mr. Fynn's attempt at a new classification; but he can hardly blame me for not making use of his system, which was not published until a fortnight after my remarks had been made. To show my appreciation of the new names, I will attempt to use them in this letter.

To answer Mr. Fynn's questions: The motor which I have suggested is likely to allow of better commutation than the series conduction machine without transformers, because the voltage across the commutator can be reduced to any desired extent, whereby the armature turns, and consequently the reactance voltage, may be kept within reasonable limits.

Of course, this motor is "simply an ordinary series conduction motor with which a transformer is combined" in a particular way, whereby it becomes what I think Mr. Fynn would call a series induction motor. I may here remark that the repulsion motor might also be described in the same way. But in the former case, it is the value of this particular way which Mr. Fynn misses entirely. Consequently he suggests to me, as an improvement, the placing of the stator coils in such relative positions as would destroy completely the characteristics of the machine. For his improvement is, in short, a variety of shunt induction motor, while mine is intended to have the characteristics of a series induction motor.

It is clear from this that Mr. Fynn has not grasped the following principle:—"Two or more electric circuits excited by being placed magnetically in series (*i.e.*, as secondaries upon the same limb of a constant potential transformer), behave as electric circuits in parallel, due regard being paid to the ratio of turns." And similarly:—"Two or more electric circuits excited by being placed magnetically in parallel, behave almost as electric circuits in series, due regard being paid to the ratios of turns to the various magnetic reactances." The first is Mr. Fynn's case, the second mine.

William Cramp.

Manchester, *April 23rd*, 1906.

Preservation of Hanger Bolts.

I am sure that Mr. Warr need go no farther than leakage, and consequent electrolysis (in presence of an electrolyte), for an explanation of his troubles.

If a trolley wire is single insulated, the hanger deteriorates more quickly than if leakage had to get across two insulators in series. While the positive end of an iron insulated twin-buckle is wasted away, the galvanising of the negative end is preserved by the deposition of skin upon it. Green salts are observed at the negative end of a "Globe" or "Brooklyn" insulator, while the positive end is free. An insulator not exposed to leakage will not deteriorate like one close to it which is so exposed; and there is a very marked difference to be seen between an iron hanger bolt which has been exposed to weather alone for five years, and another which has been subjected not so much to the weather as to the splash of trolley wheels *and leakage*. The screwed end of the former will have rusted quite in the ordinary way, and the insulation will be intact, but rusting in the latter has gone right under the insulation, and may have split it in all directions.

I wish that Mr. Warr could have seen the array of

specimens illustrating my arguments which was on the table in Birmingham when a paper was read recently before the I.E.E., and I hope that he will be able to take advantage of an opportunity to see them which may present itself shortly.

Robert N. Tweedy.

Stourbridge, *April 22nd*, 1906.

Electric Winding in Collieries.

In your review of the discussion on Mr. Mountain's paper before the Institution at their London meeting, printed in your last issue, you state :—

"It must be conceded that electric winding has not been proved better in point of cost, no actual working figures being advanced for comparable cases of electric and steam winding." I beg to point out that I gave in my paper the actual working results at the Zollern and the de Wendel collieries, comparing them with some of Mr. Mountain's examples of actual steam winding, but allowing for wages on the English scale taken from Mr. Mountain's examples.

These actual working costs were obtained during a complete 24 hours working day, which was apparently not the case with Mr. Mountain's figures for steam winding; the latter would have come out even higher, as they do not at present include standing losses between the shifts, lowering for timber, miners, &c.

These actual results were taken with great care, especially at the Zollern colliery winder, which is built for 2,000 tons in 8 hours from a depth of 550 yd. at a maximum speed of 66 ft. per second. They were obtained by the Boiler Insurance Co., and gave the following results in steam consumption: winding for the present only 2,420 tons in 15 hours from 330 yd., besides 1,000 miners, timber, rope inspection, &c.; 29 lb. steam per useful H.P.-hour; 17·5 lb. steam per unit delivered to the mains.

Per 100 tons of coal wound this results in 5s. 7½d., including interest and depreciation at 10 per cent. spread over 15 hours, 250 days per year, as stated in my paper.

Looking in Mr. Mountain's list of steam winding collieries for an equivalent, we find the Sherwood Colliery, with costs at 6s. 3¾d. per 100 tons wound, the nearest as regards length of shift, output and depth. At the same time this is quite a modern steam winder using superheated steam. The winding and banking times also fairly correspond to those at the Zollern Colliery (49 seconds). The higher output per day and longer shift at the Sherwood Colliery are entirely in favour of the steam winder, but this is somewhat compensated by the greater depth. It must not be forgotten that for the full output of the Zollern engine, 4,000 tons in 16 hours from 550 yd., the cost will be about 4s. 6d., surely a substantial saving.

Gerald Hooghwinkel, M.I.M.E., M.I.E.E.

London, S.W., *April 23rd*, 1906.

[Omitting altogether the fact that Mr. Mountain contests the accuracy of the above figures, making them for Sherwood, 4s. 8½d., and for Zollern, present results, 6s. 1¾d., our correspondent himself shows that *comparable* results (*i.e.*, actual working figures) of steam and electric winding were not given.

Moreover, we venture to suggest that any such results must arise from British practice, in order to be of practical utility in this country.—Eds. E.R.]

Technical Education and Research.

Your leader of last week dealing with the above subject, in which a large part of the electrical profession will heartily concur, showed in a very able manner two things: First, a bold and original appreciation of a most important matter; second, the courage of your opinions in publishing the same. One of the chief points of weakness in our system of technical education is the failure to realise that it is not so much the amount or complexity of apparatus which contributes to the production of the successful student as the appreciation in their true proportions of the inherent mental qualities of the student, and especially that rarely met with quality, which you rightly count so large a factor, the blessed quality of enthusiasm.

Without entering too deeply on the psychological side of the problem, it is safe to say that no two students assimilate ideas by precisely the same mental process; and whatever may be the lecturer's or teacher's method of instruction, it does not necessarily follow that his train of thought will present the same "colour" to the student as it does to himself. There is large scope for improvement in the presentation of ideas.

To briefly sum up. It is in the period of afterthought, after a subject has been carefully thought about, not vicariously, by someone paid to think for him, but by the student himself, that the matter has been truly assimilated. In my experience of lecturing and technical school work, although I am only young in this respect, this stage of knowledge on the part of the student is easily recognised by the various suggestions he offers, in the case of apparatus, for the different working of the thing or things.

Then the teacher can thank his lucky stars that the seed has not fallen on stony ground, and that it is no longer a question of how much apparatus, or how little apparatus, is at disposal, or the style of architecture of the building in which the tuition is carried on; the decision has been carried to a higher court, and the personal enthusiasm of the student has come into account.

It is just this personal enthusiasm which you rightly hold to be so large a factor in the matter of technical education and research, which cannot be purchased by all the wealth in the State, and which sooner is encouraged by a paucity of apparatus, than by overmuch, and which will press into service anything and everything as a means to the end. This is amply borne out by the early lives of the discoverers you mention, Faraday, Hughes, and many others. These were at one time but inadequately supplied with apparatus or means to prosecute their investigations, but the fact remains that difficulties only appeared to stimulate them to further effort. I know of nothing so heartening and encouraging as to see the successful working of a piece of apparatus or mechanism such as a poor student would scrape together by any means in his power to demonstrate some idea which has been dominating his thoughts, and towards the vindication of which he has bent his whole energies.

What is the upshot of all this? How can we make the most of our national resources for technical education and research? It is in effect what you have so ably endorsed in your leader. That undue elaboration of a central scheme housed in a central building is not advisable or efficient compared with a wider dissemination of that wealth "to fatten lower lands" and to help on many scores of students throughout our land.

In lighter vein: "Now remain three things: wealth, buildings and enthusiasm, and the greatest of these is enthusiasm."

Alfred V. Newell.

Leicester, *April 24th*, 1906.

The Separation of Oil from Feed Water or Exhaust Steam.

I have read the article by Mr. J. H. Harwood on the above subject with great interest, and, as a manufacturer of separators on the baffle principle, I would, with your permission, like to state that Mr. Harwood does not appear to me to have weighed the merits of the respective apparatus very impartially. He shows a very strong predilection for treating the condenser water by a chemical apparatus and filters, and by his own admission the cost of such treatment, irrespective of the interest on the original outlay, cannot be much less than 25s. or 30s. per week, because he says that "the apparatus requires a fresh supply of chemicals each day, which takes an attendant half an hour," and later he tells us that when running on full load the filter beds, which are on no small scale, require cleaning out about every five hours, and in my opinion the above estimate is a very low one.

Now in the case of separators on the baffle principle, the steam is taken in hand in the first instance, and the grease separated from the steam before it is condensed, without giving it the opportunity of becoming emulsified, and Mr. Harwood himself points out the great difficulty that there is in separating grease when once it has been thoroughly incorporated with water.

Now as to the cost of running a baffle separator, there is no expenditure whatever except the original cost, as I can refer to apparatus on that principle which have been running very satisfactorily for upwards of eight years, and have never either been cleaned out or had a cover taken off for any purpose since being erected.

I would have been glad to have gone more into details, and to have subscribed my name to this, had it not been that it would have looked as if I was endeavouring to get a cheap advertisement, but I would like to impress upon steam users that the usual guarantee which I give with my separator, namely, that the steam after passing through this apparatus will not contain more than one-third of a grain of grease per gallon, when condensed, or, say, one part of grease in 210,000 parts of condenser water, is sufficient to satisfy any ordinary requirements.

J. B.

We note that in Mr. J. H. Harwood's article on "Separation of Oil from Feed Water," in your issue of 13th inst., he mentions the amount of energy used by our electrical process of separation as averaging 1½ units per 1,000 gallons of water treated. This is high, as, except in very special cases, or by neglect, it need seldom be even as high as 1 unit per 1,000 gallons.

Davis-Perrett, Ltd.,
Ernest Perrett, *Managing Director.*

London, E.C., *April 23rd*, 1906.

The Naval Engineer and Electricity.

The chief object of my much-criticised article written under this title was to arouse an earnest interest among your readers in Naval affairs. I trust that we shall not weary them with this correspondence, which, I am sorry to say, has but little to do with electricity.

In your last issue "M.I.Mech.E." says that "it may surprise him to hear that the engineer officers, as a whole, are in favour of the new system, and that if a ballot were taken five out of every six would approve of it." Contrast this with Mr. Appleyard in the same issue:—"I am *fully in agreement with Mr. Smith* that if a ballot were taken among the engineer officers, but one in five would approve of the present system." Referring to the artificer's grievance, I feel that Mr. Appleyard does not view this question enough from their standpoint. Would central station engineers-in-charge view the systematic promotion of stokers to charge duties without demur? Finally, I would quote an excellent report of a recent meeting, as given in the *Engineering Times*. It is (abstracted) as follows:—

A joint meeting of the Institute of Marine Engineers and the London Association of Foreman Engineers and Draughtsmen was held at the Cannon Street Hotel, when Mr. W. J. Harding (retired fleet-engineer of the Royal Navy) read a paper entitled "The Defence of the Realm." The paper dealt with the engineering *personnel* of the Navy, especially in regard to the proposal that stokers should be trained to act as watch keepers.

Mr. Harding, in the course of his paper, expressed the opinion that those tasks which required a seaman's skill should be kept separate, and be performed by a diminishing number of men, whom they might regard as the equivalent of the sailor of old. In respect of the mechanical branch, he expressed the opinion that the stoker would never be able to fill satisfactorily a position of individual responsibility, and that there was a good deal of truth in the saying, "Once a fireman always a fireman." Long observation had convinced him, in fact, that it was inadvisable, as a rule, to make a stoker alone responsible for the working of the machinery or boilers in a warship, and on that account he doubted whether he would ever be a successful substitute for the existing professional engineer as a watch-keeper. The plan had been tried before, both in our own and other navies. It had also been tried in the mercantile marine, but those trials had not been attended with success.

Mr. James Adamson (hon. secretary of the Institute of Marine Engineers) moved the following resolution, prefacing it by urging that the engineers for the Royal Navy should have at least as good a practical and theoretical training as that found to be necessary for the liners of the merchant navy:—"That this meeting of mechanical and marine engineers desires to place on record its entire disapproval of that portion of the Admiralty policy—known as the Cawdor statement—wherein it is indicated that the future engineer officers of the Navy are to be interchangeable with the deck officers, as such a course must inevitably result in a loss of efficiency in engineering skill so far as the officers are concerned. Next, with regard to the substitution of stoker mechanicians for the highly technically trained engine-room artificer, such a retrogressive step will, in the opinion of this meeting, lead directly to such a loss of matured mechanical ability that will amount to a national loss, and will most assuredly result in a national disaster; and that, further, in the opinion of the meeting, it is most desirable that every encouragement should be given to young men serving their apprenticeship in the leading engineering works of the country to qualify themselves for the national Navy by a system of pass-examinations." Mr. Thomas Mullock seconded the resolution, which was carried unanimously.

This resolution puts the position in a nutshell so far as the stoker mechanicians are concerned.

I would take this opportunity to thank you for devoting so much space to this subject, which is of great importance to all engineers.

C. Alfred Smith.

London, W.C., *April 24th*, 1906.

REVIEWS.

Les Quantités Élémentaires D'Electricité, Ions, Electrons, Corpuscules. Mémoires réunis et publiés. By Henri Abraham and Paul Langevin. Paris: Gauthier-Villars. 1905. Price 35 fr.

This work, in two volumes, having a total of about 1,133 pages, is intended as a work of reference for the advanced student of physics. It is one of the series of publications of the Société Français de Physique, so that it is hall-marked as an up-to-date publication, apart altogether from the fact that its editors are two most distinguished scientists.

The first chapter on the "Dynamics of the Electron" is a paper by Max Abraham, and is a mathematical discusssion of 48 pages. In this the work of Kaufmann on Becquerel rays is discussed, and the work of Heaviside and J. J. Thomson on the magnetic energy of an electron at low speeds, and the apparent mass of an electron supposed spherical at high speeds, and also the work of Searle and Lorentz, are referred to.

The writer of the paper then proceeds to build up a theory on a purely electro-magnetic basis, the electron being supposed spherical, with uniform distribution of charge, &c. Then there follow chapters on fundamental equations, electro-magnetic energy, movements of the electron, electro-magnetic mass, &c.

Lagrange's functions are applied to the calculation of the difference between the magnetic and the electric energy of the electron; and it is shown that with cathode rays, when the velocity is small, the electric energy is independent of the speed, and the magnetic energy is proportional to the square of the velocity, as the potential and kinetic energy is in ordinary dynamics. As the author remarks, it is extra-ordinary that ordinary dynamical equations are applicable to such things as these.

Next there is an abstract of Aitken's celebrated paper on "Mists and Fogs," from the proceedings of the R.S.E., followed by papers of Becquerel, L. Benoist, Bloch, Chattock and Crookes on "Radiant Matter." With regard to the latter, it may be observed that J. J. Thomson's explanation of the effect observed by Crookes is added in a footnote to this paper.

Some little prominence is given to views by Deslandres and S. Arrhenius on emission of particles from the sun, and some simple explanations are mentioned of auroræ, &c., in accordance with these modern views. The reason why only the smaller particles reach the earth's atmosphere is clearly explained. In this connection, although, perhaps, outside the scope of this work, it would have been very interesting to have had the learned editor's views of the sun's 11·1 and 60 year periods, and the recurrence of sun spots, auroræ and magnetic storms. A year or so ago it was mentioned by a high authority in this country that an investigation regarding the effects of movements of particles in the higher atmospheric strata was being undertaken by certain meteorologists in Germany. In the meantime, however, the results do not appear to have reached "the man in the street."

Possibly, now that Prof. Langevin has applied the corpuscular method to explain the molecular or "Amperian"

magnet (*vide Electrician*, October 27th and November 3rd, "Theory of Magnetism," P. Langevin), we may hope ere long to see a great deal of light thrown on this mysterious branch of physics.

In the *résumé* of papers by J. Stark on "The Mechanism of the Electric Arc" there is a considerable amount of work of practical importance. He shows how vaporisation occurs, and how the positive and negative ions appear at the cathode. The so-called minimum potential of the arc is the sum of the falls of potential at anode and cathode. The anode fall is a variable depending on a variety of circumstances, whilst the cathode fall is a potential of ionisation, which is independent of temperature and vapour pressures, and is a property of the substance.

In this connection it is interesting to notice that A. A. Campbell Swinton has recently read a paper (abstracted in the Elec. Rev. of December 29th, 1905) on the "Transit of Ions" in the arc. In this paper experiments are described in which the positive or negative ions are shown to be deflected into a Faraday cylinder, by means of a magnet, by a somewhat similar arrangement to that adopted by Perrin with cathode rays. A. A. C. Swinton's results appear to show that the views enunciated by J. J. Thomson in his work "Conduction of Electricity through Gases" are correct. This theory assumes that the positive and negative electrodes respectively emit positive or negative ions, which travel through the arc in opposite directions, and the electrodes suffer from the bombardment.

There is also an abstract from Chapter VI. of Dr. Larmor's "Aether and Matter" on the "Dynamical Theory of Electrical Action" and the Equations of the Electric Field, deduced by the principle of "Least Action," a paper by Kaufmann on "Electro-magnetic Mass of the Electrons," the earlier papers of Helmholtz on jets of steam, "Lorentz on Theory of Electrons," and many papers by J. J. Thomson, C. T. R. Wilson, McClung and others of the Cambridge school referred to in Prof. J. J. Thomson's own work, besides papers by Poincaré, Planke, &c.

Both these volumes are beautifully printed, and enough has been written above to show that such a collection of scientific papers on these subjects will be of immense use to students of physical science in this country and abroad.

The reviewer does not notice any description of direct measurements of the velocity of the ions in chemical solutions, such as have recently been carried out by Steele, &c. Perhaps, however, this is too much of a physical-chemical matter to find a place here.

One very gratifying feature of this work is the notice taken of the immense amount of work done, and still being carried on, by British *savants* in this field.

Elementary Electrical Engineering. By P. T. White. Wigan: Strowger & Son. 1905. Price 4s. 6d. net.

The author of this book in his preface states that it is specially written as an introduction to the most advanced study of electrical engineering. In the opening paragraph of the first chapter we are informed that it is written in such a manner as to render it suitable to the requirements of the student, the mechanic, the works manager, the mining engineer, the wireman, &c.

From any of these points of view, the book is open to serious objection.

The author first attempts to define the volt, and admitting that this is a difficult task, there is no excuse for the following:—"The strength of an electric current passing round or through a circuit, depends upon the difference between two points in that circuit having regard to what is termed the 'potential' of the electricity. Potential may be defined as the power to do work."

The ampere is next dealt with. We read that:—"It is usually defined as that *quantity* of current which could be sent through a conducting path of 1 ohm resistance by an E.M.F. of 1 volt."

In dealing with the properties of the electric current, the author concludes with the following:—"The strength of an electric current is measured by the magnitude of the effects it can produce in a given time." No explanation is offered, and we are told that no previous knowledge of electrical matters will be assumed.

In fig. 3 the author shows the direction of the current in a primary cell, but does not indicate which plate is the zinc and which is the copper. A list of properties which a primary battery should have is given without any attempt to explain why ordinary cells fail. A Leclanché cell is briefly described, and this portion of the work concludes thus: "A description of the chemical actions and reactions taking place in the cell will not be of much service, and we will now proceed to describe electric bells." This in a work which, the author states, has been specially written as an introduction to the most advanced study of electrical engineering!

In dealing with telephones, the historical treatment is not very accurate, but we get a further insight into the objects of this work—"a text-book whose main object is to indicate the general principles employed."

A large number of diagrams of electric bell circuits are given, but no attempt is made to explain how a system should be designed for efficient and satisfactory working.

The descriptions of wiring systems are neither lucid nor very accurate. We read that branch distribution boards are usually single pole, and we are referred to the diagram in order to get a clear idea of the distribution board system. This diagram only shows a portion of the main switchboard.

In dealing with dynamos and motors, the author has not attempted to explain the elementary theory of the subject. We are told that "contrary to popular opinion, any dynamo can be connected up to run as a motor." The method suggested by the author for testing the continuity of the field circuit of a motor is bad.

Throughout the work, the author constantly uses technical terms which have not been explained. For example, in dealing with circuit-breakers, we read "the danger of the reversal 'beating' the operation of the instrument is eliminated in the new design now upon the market." The author states that shunted ammeters are polarised and cannot be used for alternating currents. This statement requires modification.

In the Appendix we read that "An important type of cell which is largely employed for test room and laboratory purposes is known as Latimer Clark's Standard cell;" there is no suggestion that the cell is not also to be used for the same purposes as a Leclanché cell mentioned in a previous paragraph.

This work is badly arranged, the information is frequently inaccurate and generally very badly expressed, and before the author publishes the promised work on higher electrical engineering, it is to be hoped that an endeavour will be made to correct this treatise, which at present is quite unsuited for the purpose for which it has been written.

Physikalische Grundlagen der Gleich und Wechselstromtechnik. By A. Konigswerther, Ingenieur. Hanover: Jänecke Bros. Part I. Price M. 3.20.

This is one of a series of electro-technical treatises issued in parts, such as are now so common in Germany. It is well printed, and has only 120 pages.

The treatise is divided into six chapters—Electrostatics, Current Circuits, Magnetism, Electro-magnetism, Induction, Alternating Currents—and is intended for students with some knowledge of mathematics.

In the first chapter, $f = \frac{q^1 q^1}{r^2}$ is referred to as Coulomb's Law, and it is mentioned that this was established by means of the torsion balance. The symbols refer to quantities of electricity, and the reviewer has never met with anyone who could prove Coulomb's Law under such conditions. However, this statement is found in many text-books, so that the writer is no worse than others in this respect.

Electric potential, potential surfaces, capacity of condensers, and dielectric constants are discussed in the next five or six pages in the barest and scrappiest manner possible. The capacities of cylinders, &c., are stated, but not proved, and are given in electrostatic units. The theory of dielectrics is discussed in less than a page.

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Electrostatic units, &c., are explained in a few pages, and here electrostatic, electro-magnetic units, horse power, work, joules, &c., are all mixed together in a very confusing manner. After proving that the dimensions of capacity = L this portion very appropriately stops short, finally stating "a condenser raised to one volt, by a coulomb, has a capacity of one farad." Coulomb and volt are defined thus :—

$$1 \text{ coulomb} = 3{\cdot}10^8 \ L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-1},$$
$$\text{Potential} = L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-1},$$

and a volt is a three hundredth of this, v is not referred to here.

The next chapter deals with Ohm's law—Kirchoff's laws are stated, but Wheatstone's Bridge is carefully avoided.

Electrolysis is dealt with in a page and a half, and contains a bare statement of Faraday's laws, without the reason why.

The Peltier effect occupies about three pages. What it has to do with Gleich and Wechselstrom, it is difficult to see Earth's magnetism, a more important matter, is dismissed in less than a page.

Hysteresis curves are shown, but a discussion of $\int H \, dI$, or $\frac{1}{4\pi} \int H \, dB$, is avoided, Steinmetz's law being given instead.

In fact, there is nothing of interest in this book. Any student reading it will find the usual style of thing, alternating current treated after the sine wave fashion with its accompanying vector diagrams. Form factors are given for waves of semi-circular, semi-elliptical, and other shapes, and finally, of course, it is casually noted that—

$$A = A_1 \sin \omega t + A_3 \sin 3 \omega t + A_5 \sin 5 \omega t + \ldots .$$

The book is of little or no educational value, except as showing how not to do it, and in this respect does not differ essentially from a good many English works dealing with similar subjects.

Of a treatise ostensibly written to explain the fundamentals regarding continuous and alternating currents, one would have expected better things.

Wireless Telegraphy. By A. F. Collins. New York : McGraw Publishing Co. 1905. Price $3.

This work professes to treat wireless telegraphy in all its various phases in such a manner as to render it not only a popular exposition, but a work of utility to the highly-trained specialist. Such, at least, appears from the preface to be one of the aims of the author. It cannot be said that he has succeeded.

The profuse illustration throughout the work, in itself a very desirable feature, casts a glamour over the work which favourably impresses one at first sight ; but, unfortunately, the text is singularly weak and unreliable in many parts, nor is the author up to date in his treatment of the subject from a practical or theoretical point of view, important advances in the direction of tuning and combining resonant systems, brought into use at least two years ago, not being mentioned.

It will not be necessary to dissect the work to reveal its weak points. They are general, in that the author fails to display a sufficient grasp of the subject to indicate that he is qualified to edit an essay of the kind. Within the first few pages we find the term "weight" used in place of "mass." A little further on the copper grid polariser is stated to cut off waves when the wires of the grid are at right angles to the direction of the oscillations, and transmit them when the wires are in the same direction. Different theories of wave propagation are touched upon without being explained, but the illustrations used in the work are sufficient evidence that the author has failed to grasp the elementary principles of wave formation, in that the detached waves are shown as electric fields precisely the counterpart of the electric field about the vertical conductor. The theory of conduction and reflection of waves by the upper strata of rarefied air is strongly supported by the author, who is apparently ignorant of the fact that rarefied air is not necessarily a conductor at all until it is made so by the effect of an electric discharge or other process. In the descriptive part, though less frequent, other errors distinctly traceable to bad information are met with, though it must be admitted that the author is not entirely devoid of some ability in rendering his descriptions lucidly.

In a work by this author, one naturally turns to the section on "Wireless Telephony" to see whether any further information is given as to the *modus operandi* of the Collins wireless telephone, of which numerous popular notices have appeared, but never a full technical description. The section in question is very brief and very disappointing. A system is mentioned which combines earth leakage apparatus, and a Hertzian oscillator in some unintelligible manner, but it appears clear that Hertzian waves have nothing to do with the results obtained, and that there is little or no real value in the scheme. The author, in referring to the operation of this system, gives the following very clear (!) explanation :— "The waves impinging on the receiving circuits surge with the same frequency, and have the same amplitude of vibration, though *diminished volume* of the original currents of the emitting circuits." The italics are ours.

BUSINESS NOTES.

Trade Marks in Australia.—Messrs. W. P. Thompson & Co., patent agents, Liverpool, write as follows :—

The Australian Commonwealth Trade Mark Act came into force on April 27th last. The table of fees had not been issued at the date of our advices, but we now learn that the stamp duties are double those under the new English law. The Trade Mark Law extends to the whole Commonwealth, and any trade mark already registered in any of the States of Australia can be extended to the whole of Australia, unless previously applied for in any other state by another party. In nearly all other points which concern an English trade mark owner, the Australian law is a copy of the new English law, with the exception, of course, that Australian persons, law officers and courts are substituted for English ones. As (subject to extremely strong proof of superior right by another party) the first applicant will be considered the rightful owner of the trade mark, and in other countries noted English firms have lost valuable trade marks through others registering their marks first, it is very desirable that all English firms wishing to have their trade marks registered in Australia should apply promptly. Numerous firms, indeed, have already through our advice or otherwise had their applications placed a month ago ready in Melbourne, so that the moment the Act came into force they could be entered for registration.

Brush Contracts.—The following orders have been booked by the Brush Electrical Engineering Co., Ltd. :—

For the Jarrow Tramways.—Six double-deck tramcars complete with Brush trucks and motor equipments.
For the London and District Motor-'Bus Co.—15 motor-'bus bodies.
For the Wolsely Motor and Tool Co.—20 motor-'bus bodies.
For the Great Yarmouth Corporation.—Three double-deck cars complete with Brush trucks and motor equipments.

Turbine Contracts.—We learn that Messrs. C. A. Parsons & Co. are now installing a plant for the Dublin Port and Dock Board, consisting of three 200-kw. turbo-generators, together with boiler house, boilers, condensers, switchboards, cables, &c. They have also just completed a large turbo installation in London, this plant consisting of four 500-kw. and four 2,000-kw. turbo-generators, complete with condensers, motor-driven pumps, &c. Amongst the more important contracts which Messrs. Parsons have booked during the past few weeks are orders for :—

One 3,500-kw. turbo-alternator and exciter, for the Newcastle-on-Tyne Electric Supply Co.'s Carville power station.
Two 500-kw. direct-current turbo-generators, for Messrs. A. Guiness, Sons and Co., of Dublin.
One 800-kw. turbo-alternator and exciter, including condensing plant, for Messrs. Preece & Cardew, for the Shanghai Council.
One 2,000-kw. steam turbine, for Messrs. Vickers, Sons & Maxim, of Sheffield.
One 400-kw. continuous-current turbo-generator, for the West Bromwich Corporation.
One 200-kw. continuous-current turbo-generator, for the Morgan Crucible Co., Battersea.

For Sale.—The General Post Office is offering certain old stores for sale. The Bournemouth and Poole Electricity Supply Co. has meters for sale. Sunderland Electricity Department is offering for sale certain steam dynamos, motor alternators, switchboard, and feed waterheaters, of which some particulars appear in our advertisement pages to-day.

Thermit Rail Welding.—We learn that Thermit, Ltd., are now carrying out the following contracts for rail welding: Leyton U.D.C. Tramways, about 18 miles; Harrow Road and Paddington Tramways, about 7 miles; Jarrow and District, about 3½ miles. They have also received an order from the Croydon and District Tramways, about 10 miles, and smaller orders from Liverpool, London United Tramways, &c. They also hold orders for welding material and appliances from Glasgow, Plymouth, Nottingham, Darwen, Cork and other authorities.

Hodges' Switches.—Messrs. Cecil Hodges & Co. write from Balfour House, E.C., stating that it has been brought to their notice that their "V" type switch is being copied, and that inferior ones are now placed on the market under the same name. As they originated this switch many years ago to meet the requirements for a switch with a large laminated contact surface, and low current density, and have expended much time and money in perfecting it and getting it generally known, they do not wish it to be confused with imitations.

Condensers for Steam Turbines.—A new form of condenser has been brought out by Messrs. W. H. Allen & Co., of Bedford. It is in the form of a foundation for the Curtis type of turbine, the turbine being bolted directly upon the open top of the condenser, and the foot step of the turbine being within the condenser itself, so that there is no stuffing box for possible air leakage, and, exhaust pipes being eliminated entirely, a minimum chance of air leakage. Two forms are illustrated in *Engineering*, from which we take our description. One is of a surface condenser with the tubes divided and supported by dispersion or directing plates. There are two sets of tubes of $\frac{3}{4}$ in. outside diameter, disposed apparently for four passages of the water, though the description states that "several" passes are made through the length of the condenser. The tubes are packed with callon and brass screwed ferrules. In the other type of condenser the same general arrangement is made, but the principle of jet condensing is adopted, there being four rings of bronze pipes in the condenser, each carrying a number of atomising nozzles, which spray the condensing water throughout the path of the exhaust steam. No particulars of ratios or capacities are given, which is a pity, for the location of these condensers seems to be very convenient and well designed.

Exterior Lighting by Mercury Vapour Lamps.—The first installation of Cooper-Hewitt mercury vapour lamps for exterior lighting in this country is now to be seen outside the *Tribune* offices in Bouverie Street, E.C. The six lamps installed are each of 800 c.p., enclosed in a specially-designed weatherproof lantern, and give a brilliant mauve light, which illuminates the large building with startling brilliancy. The lamps do not differ from the ordinary form now used extensively for indoor lighting. They are 45 in. long × 1 in. diameter, and work on a 200-volt direct-current circuit. It will be remembered that they are

Exterior Lighting by Mercury Vapour Lamps.

started by tilting the tube so that the mercury flows from one electrode to the other in a small stream. The metallic mercury momentarily connects the two electrodes, and as the stream breaks an arc is formed, which increases the vapour pressure. The vapour then becomes luminous. The lanterns, accordingly, had to be constructed in such a manner as to make the tilting of the lamps possible. They are suspended on trunnions, by which the lantern and lamp are tilted together by hand. The weatherproof lanterns outside the *Tribune* offices were designed by the British Westinghouse Co., who hold the patent rights of the Cooper-Hewitt lamp for the United Kingdom.

Trade Announcements.—The Horsfall Destructor Co., Ltd., of Leeds, whose foreign trade is increasing, are about to change their London address from 19, Old Queen Street, Westminster, S.W., to 110, Cannon Street, E.C. The head office will remain as heretofore at Leeds. The Westminster office has hitherto been conducted as a branch office with a small staff. The new city office will be under the supervision of the well-known firm, Messrs. Findlay, Durham & Brodie, who keep a large technical and commercial staff. After May 1st, all postal communications should be addressed to "The Horsfall Destructor Co., Ltd., 110, Cannon Street, London, E.C.," and cables and telegrams as heretofore to "Destructor, London."

Mr. David Alexander, A.M.I.E.E., of 43, Mains Street, Glasgow, has been appointed by the Adams Manufacturing Co., of London, their agent for the sale in Scotland of their patent Sturtevant "Igranic" motor starting and controlling appliances.

Messrs. Bray, Markham & Reiss, Ltd., inform us that Mr. David Alexander, of 43, Mains Street, Waterloo Street, Glasgow, will not be their agent after the end of this month, and that they have appointed Mr. John A. Rudd, of 177, West George Street, Glasgow, as their new agent. They have also appointed Mr. Arthur Pearson, of 27, Paradise Street, Birmingham, their sole agent for the Midlands, and are making arrangements to keep a stock of switches in Birmingham.

Messrs. Harry May & Co., electrical engineers and contractors, have removed from Conduit Street, W., to 25, Savile Row, Regent Street, W.

Messrs. Monte-Callow & Co. have recently been appointed sole selling agents for Great Britain and Colonies for direct-acting electric capstans for continuous and polyphase current, manufactured by M. Hillairet Huguet, of Paris. These capstans are intended specially for use in railway shunting yards, the Northern Railway of France having over 300 of these capstans in daily use on their system. The first of these were fitted in 1888, and are still working satisfactorily. The capstans are made entirely without gear, the capstan head being keyed on to the armature shaft. Messrs. Monté-Callow are about to fix a trial one for an English railway in connection with important dock sidings.

The Electrical Co., Ltd., announces that Mr. Lestock-Forbes has ceased to be manager of its Newcastle branch, and has left their employ.

Triumph Stoker, Ltd., announce that their registered office has been transferred to the works, 85, Kirstall Road, Leeds, where all future communications should be addressed.

Book Notices.—"Repetitorien der Elektrotechnik." Edited by A. Königswerther. Vol. X. "Projektierung von Elektrizitätswerken." By F. Hoppe. Hanover: Dr. Max Jänecke. M. 3.80.

The *West Ham Electrical Bulletin*, of which No. 1 has just been received, is being issued quarterly by the Corporation electricity department, with the object of securing the attention of the possible consumer of electric light and power, and keeping him informed on certain matters regarding which he is in need of knowledge. A biographical sketch of the chairman of the Electric Light and Tramways Committee, a time-table and list of fares for the electric tramways, and particulars of a scheme for hire-purchasing electrical fittings are among the features of the April number.

"Photographische Aufnahmen von Radium Körnchen im eigenen Licht," and "Einige weitere Bemerkungen über Blitze und photographische Blitzaufnahmen." By B. Walter. Excerpts from *Annalen der Physik*. Leipzig: J. A. Barth.

"Technology Quarterly and Proceedings of the American Society of Arts." Vol. XIX, No. 1, March, 1906. Boston, Mass.: Mass. Institute of Technology.

"Physical Review." Vol. XXII, No. 4, April, 1906. Lancaster, Pa., New York and London: The Macmillan Co.

"Proceedings of the American Institute of Electrical Engineers." Vol. XXV, No. 3, March, 1906. New York: The Institute.

"Fire Tests with Doors." Red Book No. 111 of the British Fire Prevention Committee. London: The Committee. 2s. 6d.

"Transactions of the American Electro-chemical Society." Vol. VIII. 1905. Philadelphia, Pa.: The Society.

West Australian Contracts.—Owing to the slovenly manner, says the *Electrical Record*, in which the specifications for the extension of the electrical plant of the Midland Junction Municipality and other municipal contracts had been prepared, the principal electrical contracting firms in the State wrote a letter of protest to the Council, urging that proper specifications should be drawn up by independent advisory engineers—failing which, they threatened to refrain from tendering.

Consular Reports.—Roumania.—The German Consul at Bucharest states that porcelain insulators for telegraph and telephone purposes are chiefly imported from Germany. In recent times, however, Austrian makers have quoted such low prices that the trade with Germany has somewhat suffered. Electric lamps and accessories of all kinds find an increasing demand, owing to the installation of electric lighting in many of the towns. It is recommended that manufacturers should keep the market well supplied with samples in view of the increasing trade. Later in his report the German Consul states that the length of telegraph line in Roumania amounted to 7,012 kilometres in 1904, with a total length of wire of 18,383 kilometres. The development of telephonic communication during the last 10 years has been very rapid. In 1904 there was in the towns a length of line of 595 kilometres with a double length of wire of 6,075 kilometres. There are 11 long-distance systems between towns with a length of line of 863 kilometres, and a length of wire of 2,283 kilometres. In addition there are 1,970 inter-departmental systems with a length of line of 19,396 kilometres, and a length of wire of 21,464 kilometres. Private systems amount to 768, with a length of line of 2,353 kilometres, and a length of wire of 3,054 kilometres. There are 128 central telephone stations, 2,682 public call offices, and 3,127 subscribers. With reference to the tramways the Consul states that the town of Jassy possesses the most important system of electric tramways in the country, with a length of line of 17 kilometres. Braila and Galatz have each 13 kilometres, whilst Bucharest possesses only $5\frac{1}{2}$ kilometres. On the other hand, the length of the horse tramway systems in Bucharest amounts to $44\frac{1}{2}$ kilometres. The first line, built by an English company, was bought by a Brussels syndicate and electrified, as well as being extended. The old company was styled the Première Société Anonyme Roumaine de Tramways, but there is a new company styled the Société Anonyme Roumaine pour la Construction et l'Exploitation de Chemins de fer et Tramways. It is proposed to amalgamate the two companies, to convert the entire system to

electrical traction, and to make a further extension of 20 kilometres. There are at present in the country 5,512 kilometres of electrical tramways, and 44,598 kilometres of horse tramways.

Siam.—The Austro-Hungarian Consul at Bangkok reports that the Siam Electricity Co., of Bangkok, propose to purchase motor-omnibuses.

Poland.—The British Consul at Warsaw reports that in 1905 little or nothing was done towards the introduction of electric traction for the tramways, but it is stated that if there be no further strikes or disturbances electric cars will commence running on October 1st next. To allow the complete programme for the electric tramways to be carried out, which includes the extension of the present system of 28 versts (19 miles) to 35 versts (24 miles), two viaducts have to be built, but it is not likely that it will be done this year. Electric lighting is also promised this year for the streets through which the tramways will not run. Later in his report the Consul states that owing to the generally disturbed state of the country the demand in 1905 was very small for machinery and mill furnishings, with the exception, perhaps, of electric motors, which were imported in anticipation of the higher import duty under the new tariff, which came into force on March 1st last.

Costa Rica.—The German Consul in Costa Rica reports that the telegraphic communications of the country are controlled by the Government. The length of line amounts to 1,450 kilometres—about three times the length of railway line. Costa Rica is in communication with the outside world by means of a cable from Nicaragua. From San Juan del Sur a cable connects with Panama and South America, whilst another cable communicates with Europe, *vid* Galveston. There is no cable on the Atlantic Coast. Wireless telegraphic communication exists from Limon to Bocas del Toro and Panama. There are telephone systems in Limon and San Jose and between these two towns, altogether a length of line of 327 kilometres.

Norway.—In a recent report the British Consul states that it is customary to send home to the Board of Trade such particulars and samples as can be obtained of contracts open to public competition. These are chiefly municipal and government contracts for such goods as clothing for the army and navy, coal (locomotive and gas), telegraph and telephone materials, fencing, rails, tarpaulins, railway tools, files, pipes and tubing. It is true a certain amount of preference is shown by the Government, though not necessarily by the municipal authorities, to Norwegian manufacturers, where such exist and compete, but there are many cases in which such are absent, and others are therefore on an equal footing, both as regards treatment with respect to preference and in payment of import duties. In the case of Government contracts, it is desired that tenders shall be sent in by agents—of what nationality is immaterial—who reside in Norway, in order to facilitate negotiations for the authorities, an exception being, however, made on recent occasions in the case of Navy contracts, which, in the case of foreign firms "well known" to the authorities, may be tendered for direct. A list of persons likely to be prepared to tender for British firms is sent home to the Board of Trade from time to time for the information of applicants, thus effecting a saving of time when the period allowed for tendering is short. On the other hand, it should be noted that comparatively new firms have little chance of obtaining these contracts, there being a tendency to avoid giving them to firms if any doubt exists in the minds of the authorities as to the would-be contractor's complete ability to carry out the contract.

Negotiations have for some time been going on between the town of Trondhjem, as owner of the Lerfos waterfalls, and a foreign syndicate with reference to the leasing of a certain amount of electric power—up to 12,000 H.P.—for projected steel smelting works to be erected by the said company at that port. The negotiations have been carried so far that the town council has agreed to offer the power at the smelting works at a price of about 35 kronen (about £1 19s.) per horse-power for a period of 50 years on certain conditions.

Dissolutions and Liquidations. — Telescriptor Syndicate.—May 5th is the last day for the receipt of proofs for intended dividend. Liquidator, Mr. E. Waterhouse, 3, Fredericks Place, Old Jewry, E.C.

French Electric Lighting Boards, Ltd.—Creditors must send particulars of their debts, &c., to the liquidator (Mr. W. H. Pannell, 13, Basinghall Street, E.C.), by May 27th.

Kamm's Zerograph Syndicate.—A meeting is to be held at 27, Powell Street, Goswell Road, E.C., to hear an account of the winding-up from the liquidator (Mr. H. Beevor Harvey).

The Patent Regenerative Furnace Co., Ltd.—Meeting to be held at 13, Basinghall Street, E.C., on May 29th, to hear an account of the winding-up from the liquidator (Mr. W. Hardy King).

Catalogues and Lists.—Referring to our note on "The Magnet," which appeared in our last issue, the statement that it was issued by the British Westinghouse Co. was, we are informed, incorrect. No name of publisher appears on the paper, but as most of its articles dealt with Westinghouse material we thought we were safe in making the statement alluded to. To prevent a wrong impression being gathered, we may add that the contents do not partake of the nature of a catalogue.

Messrs. S. Wolf & Co., Southwark Street, S.E.—Illustrated price list of electric grinding machines.

Vortex Pulley and Belting Co., London, E.C.—Price list of many sizes of "B.B." wood-split pulleys, also of leather belting.

Messrs. Arthur Cort & Co., Camberwell New Road, S.E.—Wholesale price list of insulating hard or flexible vulcanised fibre, Balata, gutta-percha and cotton goods, &c.

The *Brush Budget* for April is as attractive in its get-up, matter and illustrations as any previous issues. Many photographic reproductions of tramway systems, railway rolling stock, electrically driven machinery, switchboard and plant, upon which the company has recently been engaged, appear.

Davies Patent Boiler, Ltd., 28, Victoria Street, S.W.—24 pp. booklet describing their patent water-tube boiler, and quoting extracts from a report on tests made by Mr. W. H. Booth in September last, by Mr. H. J. Donkin in November, and by Mr. W. J. Harding in October.

Automatic Fire Hydrant and Engineering Co, Ltd., 33, Minories, E.C.—Small pamphlet giving an illustrated description of their automatic fire hydrant and combined hose reel.

Maschinenfabrik Oerlikon, Oerlikon (Switzerland) (G. Wüthrich, manager), Oswaldestre House, Norfolk Street, Strand, W.C.—We have received a copy of the English edition of the company's turbine pamphlet. It contains a number of excellently produced views of Oerlikon steam turbine plants which have been supplied on the Continent, also of several departments at the works where they are made. There is a good deal of general descriptive matter, accompanied by sectional drawings of plants and steam consumption and efficiency curves. The company's turbine department has of late been greatly developed, and we are informed, is now working in full swing. There are units going through the shops of from 500 to 4,000 K.V.A., and the department will be extremely busy for some considerable time to come.

Messrs. Elliott Bros., Lewisham.—New pamphlets for the company's series:—A.C. 74, detailing portable pattern alternating current instruments for use with transformers; A.C. 72, dealing with type G G A.C. instruments; and T.S. 81, describing Ewing's hysteresis tester.

Messrs. W. H. Bailey & Co., Ltd.—Illustrated pamphlet giving illustrations, sectional and otherwise, also general and price particulars of the "Key-ring" steam stop valves, and the renewable valve-seat.

Tudor Accumulator Co., Ltd., 119, Victoria Street, S.W.—Catalogue (40 pp.) of stationary cells. Half-tone views are given of the company's works at Dukinfield, near Manchester, of the Tudor batteries employed by the Southampton Corporation tramways power station, those in the service of the County of London and Brush Co. at City Road station, and those at a central sub-station of the Cardiff Corporation. Full descriptive particulars of the various types of batteries and their manufacture are given, also tables of prices and details. Dimensional drawings and general business information are included. The company are now giving special attention to the question of small batteries, and not confining themselves to the same extent to central station batteries, for which hitherto they have been chiefly known.

London Shafting and Pulley Co., 62, Blackfriars Road, S.E.—Illustrated price list of shafting, pulleys, couplings, and so on. Prices of different sizes are set out in tabulated form. The "Mersey" motors and dynamos are also included in the list.

The Electrical Co., Ltd., London, W.C.—Leaflet No. 207, giving prices of "Sunshine" flame arc lamps. Also a circular giving prices and a few particulars of aluminium rectifiers and a card of designs and prices for multiple Nernst lamps.

Messrs. Davidson & Co., Ltd., Belfast.—Bulletin No. 2,000 giving an illustrated account of the firm's Sirocco fans for forge fires. One of the views shows a motor-driven Sirocco fan in the service of the Belfast Corporation tramways department.

Union Electric Co., Ltd., London, E.C.—Lists of prices of "Noris-Excello" arc lamp carbons for both direct and alternating currents. The list covers a large range in diameters and lengths, and gives the equivalent in inches of each carbon, and per hundred pieces.

Messrs. L. Andrew & Co., 2, Carr Street, Blackfriars, Manchester.—Wholesale price list of india-rubber shoes and boots.

Messrs. Krupka & Jacoby, Watling Street, E.C.—A few advance sheets for their new catalogue, also a binder in which to file these and other lists belonging to the catalogue, as issued. The first lists particularise incandescent electric lamps, arc lamp carbons, Liliput arc lamps, radiators, and carbon battery plates.

Lahmeyer Electrical Co., Ltd., New Oxford Street, W.C.—New controller list No. VI. E., which has been thoroughly revised and brought up to date. These controllers, which are fully described, are for electrically-driven cranes, hoists, lifts, and other variable speed machines, and they have been installed by a large number of crane-makers, railways, and dockyards. Controller resistances, continuous and three-phase brake magnets, &c., are detailed. The outer case of the Lahmeyer controller is of cast-iron, and each controller has a large blow-out coil which prolongs the life of the contacts. The list gives useful information as to the rating of the controllers, also diagrams of connections, and prices. The company also has a special design of a controller for mining work, a sample of which was exhibited at the recent Electrical Exhibition, Olympia.

Quick-Break Switch Patent.—Our attention has been drawn to patent No. 11,086 (1902) for a D.P. laminated U-type high voltage change-over switch, with only two pairs of brushes, and other useful and ingenious features. Unless this patent is speedily sold or taken on royalty, we are informed that it will be allowed to expire.

Bankruptcy Proceedings. — Samuel Hargreaves, electrical engineer, Buxton.—A receiving order was made on April 20th on debtor's own petition.

H. Jones and G. L. Cathrall (Jones & Cathrall), plumbers and electrical engineers, Wrexham. — First and final dividend of 2s. 7¼d., payable May 12th at Crypt Chambers, Eastgate Row, Chester.

Wm. Wenham, electrical engineer, Croydon.—Discharge suspended for three years from March 13th, 1906.

Robert Boyd, electrician, Llandudno.—Receiving order made April 17th on creditor's petition.

LIGHTING and POWER NOTES.

Bilston.—The electric lighting installation at the new Stonefield Schools is being carried out by the District Electric Co., of Wolverhampton and Stourbridge, for the Education Committee.

Brighton.—The T.C. on April 19th decided to reduce the alternative flat rate for energy supplied to places of worship from 4d. to 3d. per unit. The arrangement under which certain places of worship have been supplied at 1d. per unit for lighting during restricted hours on the time switch system will be determined as from June 30th next, owing to the system having been abused.

Bury.—The electricity undertaking shows a net profit of £2,600, or £300 less than in the previous year. The lessened profit is accounted for by a reduction made in charges for energy and a rearrangement of the contribution towards establishment charges.

Canada. — Drummondville.—Work on a municipal electric lighting plant is about to commence. The contracts for the hydraulic machinery and generators have been let to the Jenckes Machine Co., of Sherbrooke, Que., and the Canadian G.E. Co., Toronto. A turbine, under 11 ft. head, will develop 240 H.P. at 90 r.p.m.

Pembroke.—The Pembroke Electric Co. has recently awarded contracts for the machinery for their new power plant on the Black River. The plant consists of two 900-H.P. water turbines to operate under 120 ft. head. Each will be direct connected to a Westinghouse 500-KW. alternating current three-phase generator. For driving the exciters there will be provided two 15-in. turbines, each of about 50 H.P. The hydraulic machinery is being furnished complete by the Jenckes Machine Co., and the order for the generators and exciters has been placed with the Canadian Westinghouse Co., Montreal.

Vancouver.—The C.C. has resolved to ask the British Columbia Electric Railway Co. for a reduction in the rates for incandescent electric lighting, promised last year by the management.

Cardiff.—The question of street lighting is being considered by the Corporation. The city engineer has submitted a plan showing the streets already lighted by electricity, and those in which mains are laid, but which are lighted by gas. It was stated that the municipal authority was paying the gas company about £10,000 a year, plus £3,000-£4,000 in wages in the Corporation gas department. How does this compare with the cost of electric light? Mr. Harpur, the city engineer, is to prepare a statement on the point.

Cheshunt.—The North Metropolitan Electric Supply Co. is prepared to enter into a new agreement with the T.C. in regard to the E.L. prov. order promoted by the company. The new order includes the whole of the original area of supply, and a clause for purchase by the Council; the average charges for private lighting are not to exceed 3½d. per unit, and the price for public lighting is fixed at 3d. It was stated that a fine of £250 may be imposed if the company does not carry out the order within two years.

Continental Notes.—Italy.—The authorities of the Province of Parma have granted a concession for the utilisation of the water-power of the River Cedra at Monchio, for generating electricity for lighting and power purposes in the district.

A new company, La Societa Elettrica della Gera d'Adda is to put down a plant to light Romano di Lombardia and Caravaggo by electricity.

Bulgaria.—The Bulgarian Ministry of War has just invited tenders for an installation of electric lighting in the military school in Sophia.

Sweden.—The *Board of Trade Journal* in its issue of April 5th, stated that the Swedish Government was contemplating a request to the Riksdag for a grant for the establishment of a power station at the Trollhätten Falls. H.M. Legation at Stockholm now reports that a Bill has been introduced providing for the purchase of other waterfalls throughout Sweden belonging to private individuals. A sum of 5,000,000 kroner (about £277,000) is requested for the purpose, in order to enable the Government to carry out a scheme of working the State railways by electricity.

Coventry.—The E.L. Committee of the Corporation has prepared a report stating that it is necessary that further extensions to the undertaking should be carried out at the earliest possible moment, and has submitted the following scheme:—(1) To dispose of the following—(*a*) the 100 and 200-KW. Fowler engines and alternators; (*b*) the 300-KW. alternator connected to the Belliss engine, but not the engine. (2) To replace the present single-phase alternator connected to the Belliss engine with a two-phase alternator, £500. (3) To purchase two 600-KW. sets, £13,550 (with concrete foundations, £14,050). (4) Three new boilers, £3,450; steam and water pipes for boilers and engines, £750. (5) Extensions to boiler house, £1,000. (6) Economiser, £500. (7) To remove the present switchboard and substitute a modern cellular switchboard, £2,000; sub-station at works, £250. (8) High tension feeders with distributors, £7,500; providing meters and services to use in connection with the extra supply of energy, £2,000; transformers, with switch-gear £3,000; total, £35,000. The above scheme will increase the capacity of the undertaking for the supply of energy from 1,400 KW., as at present, to a total of 2,700 KW., which will be ample for some time to come.

India.—Hooghly River.—Advice to hand from Calcutta brings information that an application has been lodged by Messrs. Killick, Nixon & Co. and Messrs. John Fleming & Co. for a licence for electricity supply for power and traction purposes, and (in bulk) to authorised distributors for private and public lighting. The area which will be covered by the proposed undertaking excludes the City of Calcutta, but extends from Hooghly to Budge Bridge, its boundaries following the railway lines on the north, east and west. Within the district there are a large number of jute and other mills, using at present about 120,000 H.P. Power is also sought to supply energy for lighting any premises to which the licensees are supplying power.

Lancashire.—At a conference of local authorities held at Manchester on April 19th, to consider the Lancashire Electric Power Co.'s Bill, it was announced that the company had agreed to insert clauses in the Bill, providing that they should obtain the consent of any T.C. or U.D.C. having a prov. order for E.L. before proceeding to supply energy in their districts.

Leeds.—A L.G.B. inquiry was held on the 19th inst. into an application of the Corporation for sanction to borrow £3,471 for the erection of an electric lighting and gas depôt. During the hearing it was stated that the money had been spent before the application to borrow it was made.

Liverpool.—A short time ago a movement was started in Liverpool to obtain a reduction in the charges for electricity for lighting, the matter being dealt with on behalf of consumers, chiefly by a Traders' Association. As the result of the negotiations, the E.P. and L. Committee has decided to recommend to the Council that some concession in the matter of price be made to consumers.

London.—Stoke Newington.—It was agreed at the Council meeting on Tuesday to give notice to the Hackney B.C. to terminate the contract for the supply of electricity in bulk.

Southwark.—As the sum charged by the Council against the rates for electricity supplied to the public lamps, is at the rate of 2·52d. per unit, the London Electric Supply Corporation has offered to supply the Council with energy for the lamps at the rate of 1½d. per unit. The Committee has reported having gone into the offer, and recommends the Council to take no action in the matter.

Hammersmith.—We regret that, in our issue of the 13th inst., we inadvertently stated that the profit on last year's working of the municipal electricity works was £519. This is really the estimated profit for the current year, ending in 1907.

Mexico.—Further concessions have been granted in respect of hydro-electric power plants, according to the *Board of Trade Journal*. Permission to import free the machinery and apparatus necessary for the particular schemes sanctioned, has also been granted.

Newcastle.—A meeting of the Special Committee of the Corporation was held on 21st inst., to consider the Electric Supply Co.'s Bill promoted in Parliament. The *Newcastle Chronicle* states that as a result of the meeting, there is a likelihood of an agreement being come to between the Corporation and the company, and, if this is the case, there will be no opposition raised by the Corporation.

New Zealand.—Waihi.—Mr. E. K. Scott, of the University of N.S.W., recently inspected the power plant that is being installed at the Waihi Grand Junction Gold Co.'s Mine for supplying energy for winding and crushing. We give a few particulars of the plant from a description published in the *Waihi Telegraph*. The plant equipment consists of three B. & W. boilers of 10,000 lb. steam capacity at 180 lb. per sq. in. pressure, fitted with superheaters; Weir feed pumps and Edwards air pumps, together with a Green economiser, are also installed. In the engine room three Parsons-Brown-Boveri turbo-alternators have been erected. Each turbine is of 600 H.P., and was supplied by Messrs. Richardsons, Westgarth & Co. The generators are three-phase, 50 cycles at 550 volts, and are driven at a speed of 3,000 r.p.m. The switchboard was supplied by Messrs. Brown-Boveri, and the generator panels are fitted with overload magnetic cut-out switches, with time relays. The various motors in the power station are by the same makers, and work with three-phase current. The 40-stamp battery is driven by a rope-drive from a 150-H.P. A.E.G. motor, and a similar motor drives the crusher and tube mill. The erection of the buildings was commenced in October last, and it was expected to put the plant into operation at the end of last month. The electric winding engine, which has been supplied by the International Electric Co., of Liège, is driven by a 300-H.P. motor, supplied with direct current from a motor-generator. A fly-wheel generator, with fly-wheel weighing 6 tons, is interposed to take up variations in load, and neutralize the demands on the generators at starting. The consulting engineer to the scheme is Mr. Percy Allen, of Runcorn, Cheshire.

Nottingham.—A deputation representing some of the traders of the city, waited upon the Electricity Committee last week to ask for a reduction in the price at present charged for electricity.

Rochdale.—The profit on the electricity department for the past year's working is about £3,600. It is proposed to place £2,000 to reserve fund and devote £1,600 to the relief of the rates.

South Africa.—East London.—From the *Cape Argus* we learn that a scathing report has been presented to the T.C. by Mr. J. M. Lambe, the town electrical engineer, on the existing electricity scheme. He condemns the plant and appliances in practically every department, and describes the present power station as unsafe, the methods of handling coal as wasteful and unbusinesslike, the tramways likewise being capable of great improvement. He has submitted schemes for the erection of a new power station, and proposals for various improvements generally at a cost of about £45,000.

South America.—Buenos Ayres.—The German Electric Light Co. is installing turbo-generators in the power house near the docks. This station is being considerably increased to meet the demand of the electric tramway companies. The Bahia Blanca North-Western Railway Co. will also install turbines at Bahia Blanca. These two plants will be the first turbine installations in the country.

Southend-on-Sea.—As mentioned last week, a discussion recently ensued on the question of obtaining offers to take over the light railways and electricity undertakings. The motion that the Light Railways Committee be instructed to take the necessary steps to this effect was, however, rejected. It was stated that the capital outlay on the former undertaking had been £84,365, and the loss up to 1905 had averaged £1,147 per annum for the four years; the estimated profit for this year is but £30. On the E.L. scheme, £99,632 had been expended, and the loss has averaged £700 a year. One year a profit was made.

Stoke.—To meet the demand for energy during the coming winter, the T.C. has decided to extend its plant, and a L.G.B. inquiry was held recently into an application for sanction to borrow £5,748 to carry out the work.

Topsham.—The P.C. has decided to have the streets of the parish lit by electricity. Current will be supplied by the local Electricity Supply Co.

West Ham.—As mentioned a week or so ago, the Corporation has reduced the price of energy for lighting from 4d. to 3d. From June 30th next the charge for power purposes is to be reduced to 1d. per unit, and any consumer using a motor is to be allowed to use for lighting at power rates a number of units equivalent to 10 per cent. of the total used for power. The usual discounts are to be allowed off both lighting and power accounts.

TRAMWAY and RAILWAY NOTES.

Argentina.—The British Consul at Buenos Ayres in a recent report states that there is in Argentina a length of tramway line of 310 miles. The number of passengers carried in 1905 amounted to 168,000,000 and the receipts to £1,536,000.

Blackpool.—From Good Friday to Easter Tuesday inclusive over 300,000 passengers were carried on the Corporation cars, an excess of 42,000 on the previous year. The receipts were over £2,200, an increase of £337 over last year's takings. The total surplus on the tramway undertaking for the year ended March 31st, after paying all expenses, was £6,384. The total revenue for the year was £50,875. The net surplus on the electricity undertaking for lighting and other purposes was over £6,000, a large increase, and the best year's working since the establishment of the works.

The fares during the holidays were twopenny stages, and these have been reduced again to penny stages until the beginning of the Whitsuntide holidays.

Bury (Lancs).—The Corporation electric tramway undertaking last year yielded a net profit of £3,300, against £450 in the previous year. The gross profit was £19,567.

Canada.—The annual report of the Minister of Railways and Canals shows that during the last fiscal year ending June 30th the mileage of electric railways, chiefly comprised in the tramway systems of various cities, increased from 767 to 793, and their net earnings (£687,800) showed an increase of £62,368, the paid-up capital being £12,207,000.

Continental Notes.—Italy.—The Société pour le Traction Electrique, of Milan, has recently completed the installation of a line of electric automobiles on the trolley system without rails, between Spezzia and Portovenere. The road is very dangerous, having curves with a radius of 7 metres with very steep slopes. The power is transmitted by two copper wires of the ordinary trolley type at a height of 5·50 metres and a distance of 35 cm. apart, carried by large double-T iron posts with tubular brackets. As regards suspension and insulation, the system is similar to that for tramways. The electrical energy is furnished by the power station for the Spezzia tramways at a pressure of 500 volts D.C. The carriages are constructed on the automobile system, and weigh only about 1,500 kg., holding 14 passengers each. The electrical equipment consists of two 4-H.P. D.C motors, placed on the rear axle and directly driving the rear wheels. The carriages are provided with electric lighting and heating, and are in every respect extremely comfortable and substantial. The trolley, on the Cantono system, has given the best results, and curves of moderate radius may be traversed at a speed of from 20 to 25 kilometres. The section between Spezzia and Fezzano has been open to traffic for a little over a month, and is served by two cars, which run from 6 a.m. until 8 p.m., making 20 journeys or about 140 kilometres per day. The military authorities have not yet given permission for the cars to run past the powder magazine at Panigaglia. The service has been warmly appreciated by the public, and it is stated that other similar lines are to be initiated in the district of Spezzia. The same company has installed two other trolley services, one at Pavia for the Société pour Entreprises Electriques. A line is also to be installed in the Place d'Armes, at Milan, for the use of visitors during the exhibition. It is stated that this system of transportation has a great future in Italy, owing to the lack of means of communication and the abundance of water-power suitable for electrical purposes.

Switzerland.—The *Feuille Fédérale Suisse* of April 4th contains copy of laws granting concessions for the construction and working of electric railways between Ulster and Pfäffikon; between Schwamendingen and Uessikon; Zweisimmen and Lenk; and between Lugano and Dino.—*Board of Trade Journal.*

Spain.—The Electrica Alhamena Co. intends constructing an electric power station for supplying energy to the towns of Alhama, Totana and Librilla for industrial purposes.

The Sociedad de Gas y Electricidad has been authorised to construct an overhead transmission line from its station on the River Tambre to Santiago and to Conxo.

A new electric power station has been recently opened at Illesca.

A company was formed recently at Madrid with the object of developing two waterfalls of about 40,000 H.P. in the Province of Salamanca, to light Salamanca and the town of Porto.

A concession for an electric tramway passing through the Glorieta d'Atocha and the Paseo de las Delicias, has been granted to the Société des Tramways de l'Est of Madrid.

A new electric tramway will shortly be constructed between Zumarraga and Ascoitia.

Exeter.—The Tramway Committee, proposing to establish a system of motor-'buses as feeders to the tramway service, has experimented with a 'bus sent down from London by Straker and MacConnell, Ltd., of the single-deck type, capable of carrying 18 passengers. The Committee ran it for two hours, traversing some hilly roads in the outskirts of the city not served at present by the tramway. The first year's working of the Exeter tramways having shown a profit of nearly £2,000, the City Council is anxious to meet the demand for improved locomotion from inhabitants of outlying districts.

Gloucester.—The special report of the general manager of the Corporation Light Railways (Mr. Leonard Johnston) on the financial position of the undertaking, with particular reference to the question of fares, shows that the estimated loss on the year's working is £3,254; but taking into consideration the full capital repayments which have to be provided in the coming year, the amount required to be raised from rates is increased to £4,863.

Examining critically the whole situation in the light of experience, and the collated returns of 55 other towns where the tramways are under municipal control, Mr. Johnston finds that Gloucester is giving a better service than 19 other towns out of 51; that Gloucester ranks seventh in operating costs; that the system was not too costly in construction; and that out of 56 tramways, Gloucester is the sixth lowest in receipts per car-mile, the five which are lower having all adopted halfpenny fares, and with one exception they are losing money.

The root of the trouble is that Gloucester is not taking enough money per car-mile, and the respect in which Gloucester differs from the majority of systems is in the adoption of halfpenny fares. Out of 77 systems of which inquiries have been made, only 14 have adopted halfpenny fares over their whole system. Six of these are in large towns of over 100,000 population, and therefore only eight serving an approximately similar population to that of Gloucester have seen fit to adopt halfpenny fares.

Mr. Johnston quotes some representative tramway managers against halfpenny fares, and points out that their abolition would not affect the workmen's cars, which, by the terms of the order, must run at a maximum fare of a halfpenny for every mile. The halfpenny passenger crowds out the long-distance rider, particularly when a sudden shower of rain creates a rush of traffic.

The committee adopted the general manager's suggestion for the abolition of halfpenny fares except in the case of workmen, and also his proposal for the retention of the present stages with a minimum fare of 1d.

Hastings.—The T.C. has decided to authorise the Hastings Tramways Co. to adopt the Dolter system of surface contact electric traction for the tramways along the Front Line. The Council had endeavoured to induce the company to adopt the underground conduit system, and to agree to a certain lay-out of the tracks, both of which propositions were absolutely rejected by the company. The latter also declared its intention to request the B. of T. to appoint an arbitrator if further delay took place. The Council agreed to allow double track to be laid on the Front Line,

as suggested by the company. The work is to be carried out by the National Electric Construction Co. for the Tramway Co.

London.—Metropolitan District Railway.—On Saturday last the front carriage of a train from Wimbledon took fire. All danger was averted by the prompt detachment of the burning carriage, and no great harm was done.

L.C.C.—The total receipts of the L.C.C. tramways for the year ended March 31st last, amount to £760,629, an increase of £97,422 over the previous 12 months. The route mileage is now 51 against 46·62 at the same period of 1905.

Metropolitan Railway.—It will be noticed in our Returns Table that there is a decrease in the company's receipts as compared with the corresponding period of last year. As an explanation of this, the Metropolitan Railway from Harrow South Junction to Verney Junction, including the Chesham branch, was transferred to the Metropolitan and G.C. Joint Committee on April 2nd last, and the figures for the current year include only the Metropolitan Co.'s proportion of the joint lines earnings.

Baker Street and Waterloo Railway.—The receipts on this line continue to decrease lamentably, the traffic obtained being less than one-third of the estimated amount. It is hoped that the extension of the line to the Elephant will reverse this tendency, the present southern terminus being inconveniently situated.

Maidstone.—The B. of T. has sanctioned the extension of the electric tramway from High Street to Loose.

Manchester.—The annual report of the Manchester Tramway Committee, just issued, brings out some interesting facts with regard to the city tramway system and its working. Prior to municipalisation the old Manchester Carriage and Tramways Co. paid the Corporation a rental of £23,000 per annum for the use of the lines for horse traction. With that their liability ceased. The Corporation, as owners, had to maintain the track and provide for a sinking fund and for repairs and renewals. In the early years of the lease the Paving Committee put aside a sum yearly for renewals, but this arrangement the City Council stopped, and the money was diverted to other uses. The result was that, on the expiration of the lease, there was no reserve out of which the cost of renewals could be met, and money borrowed came into the capital account of the Tramways Committee. In regard to reserve, renewals and depreciation this Committee has all along adopted the original policy of the Paving Committee, and, in addition to paying for ordinary repairs, has put aside each year a sum sufficient to pay for the renewal of the whole of the tramway track at the end of 10 years—the estimated "life" of the tramway lines.

When it ceased to have a renewals reserve fund, the Paving Committee handed over £12,000 of the £23,000 it received yearly as rental in relief of the rates. The renewal fund now stands at £250,000. The Tramway Committee pays over £50,000 a year to the city treasurer—a sum equal to 3½d. in the £ on the city assessment. The people not only benefit in this way, they have also the advantage of greatly reduced fares. In the days of horse traction the average fare per passenger was 2d.; to-day it is 1·19d.—a reduction of nearly 50 per cent. The tramways serve a population of about 750,000, which is carried 169 times a year. In addition, the wages of the workpeople have been substantially increased, and the cost is defrayed by the department of paving the tramway track and 18 in. of the roadway on either side of the metals. Rent of leased lines and other charges cost Manchester £13,778 annually.

Rochdale.—The Corporation Tramways Committee reports gross receipts on the electricity works amounting to £43,034, and working expenses (which include £2,867 for repairs) £23,907, leaving a gross profit of £18,267. During the part of the year when the old steam trams were running the receipts were £430 and the expenditure £562, which left a deficit of £132, reducing the net profit to £18,135. This, with £40 received from the Heywood Corporation in respect of interest and sinking fund, provided in respect of cars, makes the year's profit £18,174. Of this sum interest on loans will absorb £11,070, income-tax £633, sinking fund £4,813, lease of lines in the Littleborough Urban District £1,820, and Heywood Corporation's share of the receipts £274. These items amount to £18,609, which leaves a net deficit on the year of £434. Last year the deficit amounted to £8,358. The committee intends to reduce the fare on the circular route to 1d.

The B. of T. has granted a provisional order to the T.C. authorising the construction of additional tramways in the borough.

Southend-on-Sea.—The T.C. has applied to the B. of T. for a loan of £6,974 for tramway purposes, rendered necessary by the extension of the system to Shoeburyness. It has been suggested that the tramways should be leased to a company.

U.S.A.—Chicago.—Mayor Dunne has issued a reply to Mr. Dalrymple's report on the tramway question, in which, while admitting the value of that gentleman's advice on technical and commercial matters, he discounts his opinions on the fitness of American municipalities to conduct such an enterprise. The city of Chicago, he says, decided to municipalise the tramways long before the coming of Mr. Dalrymple, and a recent decision of the Supreme Court of the U.S.A. has greatly facilitated the process.

According to the *Electrical World* of April 7th, by a referendum vote the people of Chicago have declared in favour of the municipal ownership of the tramways, but against their municipal operation. They have also authorised the issue of certificates to the value of £15,000,000 for the purpose.

West Ham.—The T.C. has applied to the L.G.B. for sanction to borrow £62,300 for the purpose of extending the tramway system. The debt of the Corporation exceeds three millions sterling, and the loss on the electrical undertaking amounts to £7,206.

TELEGRAPH and TELEPHONE NOTES.

Alpine Telephone.—According to the *Globe*, the telephone is to be invoked as an additional security against disaster to climbers in the Alps. An instrument is to be fixed in the refuge on the mountain of the Tre Croci, in the Como region, at an altitude of about 3,100 ft.

Argentina.—There has been a considerable increase in the postal and telegraph services; 1,928 offices are open, being an increase of 50 over 1904. The National Government owns and works 15,400 miles of telegraph lines, in addition to the system maintained by the provinces and the railways. The revenue of this service for 1905 was £68,700, some £5,500 more than was anticipated.

California.—The telegraphic system has been entirely disorganised by the recent earthquake; all wires leading eastward have been destroyed; and though communication has been partially restored, the panic in the city is so great and the wires so blocked that details of the catastrophe are conflicting. Those telegraph offices which escaped the effects of the earthquake were burned. The Washington authorities hurriedly connected the Eastern wireless telegraph stations with Goat Island, in San Francisco Harbour.

A Laffan dispatch stated that all the Western Union wires were down, and that all clocks stopped at 5.15.

The Atlantic companies are still refusing messages for San Francisco.

Canada.—The *Electrical World* states that the Dominion Government has abandoned the proposal to nationalise the telephones of Canada, adopting instead the policy of bringing the Bell and other companies under the control of the railway commission. The rates will be supervised, the Bell exclusive rights to enter railway stations cut off, and the company will be compelled to "give connections" (presumably intercommunication) with other companies. The proposals of the provincial Governments in favour of municipal ownership, which we have recorded, will probably be overruled.

Cement-Covered Telegraph Poles. — Experiments which were made in India some three years ago in covering wooden telegraph poles with cement put on in a thick coat over wire netting securely fastened to the pole, are said to have been satisfactory, and to have afforded absolute protection against that pest of tropical countries, the white ant.

New Zealand.—A *Times* correspondent states that both the Eastern Co.'s cables between New Zealand and Australia suddenly broke on Monday last, as the result, it is presumed, of submarine disturbances. It will take three weeks to effect the necessary repairs. In the meantime, all New Zealand cable traffic will be diverted to the Pacific route.

Stockholm.—According to a Reuter dispatch, the Government has proposed to Parliament that the State should purchase the privately-owned telephone system of Stockholm for 16,000,000 kroner (£888,890).

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Cayenne-Pinheiro	Aug. 18, 1902	
Port Arthur-Chifu (Closed)	Mar. 7, 1904	
Tarifa-Tangier	Jan. 18, 1904	
Jamaica-Colon	Jan. 5, 1905	
Cadiz-Tenerif	July 20, 1905	
Tangier-Cadiz	Feb. 18, 1906	
Trinidad-Demerara	April 9, 1906	April 19
Cayenne-Paramaribo	April 20, 1906	
Landlines.		
Puerto-Barrios	Aug. 28, 1902	
Bachkale-Deliman	Feb. 12, 1906	

Wireless Telegraphy.—A system of wireless telegraphy has recently been established between Guaymas, Mexico, and Santa Rosalia, Lower California.

British Motor-Boat Club.—The opening meeting and dinner of the season of the British Motor-Boat Club, takes place on Saturday, May 5th, at Nuthalls, Kingston-on-Thames.

CONTRACTS OPEN and CLOSED.

OPEN.

Bedford.—May 23rd. High and low tension cables for the Electricity Department. See "Official Notices" to-day.

Belfast.—May 10th. Two turbine water wheels, electric generators and pumps, for the Purdysburn Asylum. Specification to be seen at the office of the Resident Medical Superintendent, at Purdysburn.

Bermondsey.—May 18th. Condenser, cooling tower, and arc lamp lowering gear. See "Official Notices" to-day.

Bexley.—May 5th. Granite setts for the U.D.C. See "Official Notices" to-day.

Birmingham.—May 8th. Electric motors. See "Official Notices" to-day.

Darlington.—April 30th. Condensing plant for the Electricity Works. See "Official Notices" April 6th.

Edinburgh.—May 14th. Arc lamp-posts for the Corporation. See "Official Notices" to-day.

Govan.—May 30th. Stores for the electricity department. See "Official Notices" April 20th.

Leek.—May 14th. Gas dynamo for the U.D.C. See "Official Notices" to-day.

Llandudno.—May 7th. Feeder cable for the electricity department. See "Official Notices" to-day.

Poplar.—May 8th. Overhead bunker and coal-handling plant for the Electricity Committee. See "Official Notices" April 20th.

Rotherham.—May 17th. Advertising rights on the Corporation electric cars. See "Official Notices" to-day.

Roumania.—May 8th. Mayor of Turnu-Severin. Concession for the electric lighting of the town.

Salford.—May 12th. Tramway feeder boosters, &c., for sub-station. See "Official Notices" April 20th.

Southampton.—May 10th. Storage battery and chain grate stoker for the T.C. See "Official Notices" to-day.

Stoke-upon-Trent.—May 20th. Steam dynamo, condensing plant, boosters and balancer, for the electricity department. See "Official Notices" to-day.

St. Pancras.—April 30th. Arc lamp carbons for the B.C. See "Official Notices" April 20th.

Warrington.—May 8th. Motors for the Electricity Department. See "Official Notices" to-day.

Willesden.—May 1st. Arc lamp carbons, also D.C. motors. See "Official Notices" April 20th.

CLOSED.

Ashton-under-Lyne.—The British Thomson-Houston Co., Ltd., have secured from the Corporation a contract for the supply of electric motors for the next 12 months.

Brighton.—The T.C. on April 19th accepted the tender of the Improved Wood Pavement Co., Ltd., for the supply of 30,000 Jarrah wood paving blocks for the tramways, at £9 12s. 6d. per thousand.

Bristol.—The Docks Committee of the T.C. has accepted the tender of Messrs. Siemens Bros. & Co., for the supply of an electric transporter for the new tobacco warehouse at Cumberland Basin, and that of Messrs. Saunders & Co., of Cardiff, for installing the electric light in the warehouse.

Burnley.—The Electricity Committee has accepted the tender of the Klein Engineering Co. for a cooling tower to deal with 50,000 gallons of water per hour.

Exeter.—The Tramways Committee of the T.C. has accepted the tender of Messrs. Westcott, Austin & White, of Exeter, for tramcar shed extensions, at £1,473, and that of Messrs. R. W. Blackwell & Co. for overhead equipment of the tramway extension, at £609.

Glasgow.—The Tramways Committee has accepted the following offers:—

Car brake chains, D. Watson & Co.
Galvanised span wire, Allan, Whyte & Co.
O.O. "Phono-Electric" trolley wire, Bridgeport Brass Co.
Cherry bell pushes, Ross & Co.
20-ton wagon weighbridge, Henry Pooley & Son.
Traction street poles, Wilson & Union Tube Co., Ltd.
Armature coil former, Edgar S. Barralet.
Straight track rails, Bolckow, Vaughan & Co., Ltd.
7/16 galvanised wire, John Stewart & Co.
Westinghouse field coils, British Westinghouse Co., Ltd.
Whistles, J. Hudson & Co.
Rails and fishplates, Bolckow, Vaughan & Co., Ltd.
Porcelain switch bases, Port Dundas Pottery Co.
Trolley switches, E. F. Moy, Ltd.
Pitch and pitch oil, Robinson & Hunter.
Spiral punch springs, Cocker Bros.
Bitumen Tape, British Insulated and Helsby Cables, Ltd.

Leyton.—The U.D.C. has provisionally accepted the tender of Mr. Bertram Thomas for a switchboard.

Liverpool.—The Liverpool Electric Cable Co., Ltd., has received the contract for 1906-7 from the Lancashire & Yorkshire Railway, for electric wires and cables.

London.—Islington.—The Guardians have accepted, at £32 10s., the tender of Phillips Commutator Grinder Co., Ltd., for a commutator grinder.

St. Pancras.—The B.C. has received the following tenders for three hydro-extractors for the baths, to be driven by electric motors:—

E. Busby & Co.	£125	Manlove, Alliott & Co.	£148
D. & J. Tullis	134	W. E. Baker & Co. (accepted)	157
T. Bradford & Co.	137		

Manchester.—The Corporation has accepted part of the tender of the B.T.H. Co. for general stores and tramway spares, including B.T.H.-Edison lamps, for the coming year.

Plymouth.—The Tramways Committee of the T.C. has accepted the tender of the Brush Electrical Engineering Co., for the supply of six demi-cars for the West Hoe section of tramways, at £507 each.

Swindon.—The Corporation has accepted the B.T.H. Co.'s tender for the supply of miscellaneous overhead line material for the coming year.

Southend-on-Sea.—The T.C. has accepted the tender of Callender's Cable Co. for the supply of additional electric light cable.

FORTHCOMING EVENTS.

To-day's Events (Friday, April 27th).—At 5 p.m. Physical Society. Mr. C. V. Boys on "A Gas Calorimeter," and other papers.
I.Mech.E. Mr. L. Greaven on "Petroleum Fuel on Locomotives."

Saturday, April 28th.—Junior Institution of Engineers. Visit to the Croydon Gas Co.'s works at Waddon.
Association of Engineers-in-Charge. Bohemian Concert.
Tuesday, May 1st.—At 5 p.m. Royal Institution. Annual meeting.
Wednesday, May 2nd.—At 7.30 p.m. I.E.E. (Students.) Mr. H. W. Taylor on "Single-Phase Railways."
At 8 p.m. I.C.E. James Forrest Lecture, by Mr. R. A. Hadfield, on "Unsolved Problems in Metallurgy."
At 8 p.m. Society of Arts. Mr. J. B. Millet on "Submarine Signalling."
Thursday, May 3rd.—At 8.30 p.m. Chemical Society meeting.
Friday, May 4th.—At 9 p.m. Royal Institution. Hon. C. A. Parsons on "The Steam Turbine on Land and Sea."

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders are issued:—

Monday, April 30th.—"A" Company, infantry drill, 7 p.m.
Tuesday, May 1st.—"B" Company, infantry drill, 7 p.m.; lecture by Corpora King, at 8.30 p.m.; medical examination, 7 p.m.
Wednesday, May 2nd.—Nil.
Thursday, May 3rd.—"C" Company, infantry drill, 7.30 p.m.
Friday, May 4th.—"D" Company, infantry drill, 7 p.m.

Wilfrid C. Dumble, Captain.
For O.C.E.E.R.E. (V.).

Protection of Copper against Acid Fumes.—Investigations made by M. H. C. Abell with a view to finding the best means of protecting copper conductors in battery rooms have led to the conclusion that a coating of vaseline containing 20 or 30 per cent. of paraffin is the most effectual protection. After a month's exposure both to liquid sulphuric acid and to acid fumes, copper thus coated, and the coating itself, were unaffected. Tar, gum-lac, and cylinder oil were found useless.

THE LIFE AND WORK OF PIERRE CURIE.

Most of our readers will have learned from the daily Press of the tragic death of M. Curie, the discoverer of radium, on the 19th inst. The accident by which he met his death happened in the Rue Dauphine, near the Pont Neuf, where the traffic of carriages, tramways and omnibuses is always very heavy. In getting out of the way of a cab, M. Curie lost his footing. One of the wheels of a heavy two-horse dray passed over his head, fracturing the skull and killing him instantly.

Pierre Curie was the son of a Paris doctor, and was born 47 years ago, so that he passes away at an age when his scientific activities were probably at their best, and judging from what he had already achieved, the loss to science will be irreparable. He was educated at the Sorbonne, where he took successively the degrees of Licentiate of Physical Science, and Doctor of Science. Then he became a professor at l'Ecole de Physique et de Chimie de la Ville de Paris. In 1901 he was made "chargé de cours" for physics at the Sorbonne. In 1904 the French Chamber of Deputies unanimously voted a credit of 18,700 fr. to found a chair of physics for him at the Paris Faculty of Sciences, and in the following year he won an easy victory in the contest for membership of the Academy of Sciences.

Most of M. Curie's great discoveries have been made jointly with Mme. Curie, a lady of Polish birth, Marie Sklodowska, whom he married in 1895. Madame is the daughter of a college professor at Warsaw, where she was born, received her early education, and for a time gave lessons. In 1891 she went to Paris to take up a course of higher studies at the Sorbonne. Here she remained three years, obtaining the degree of licentiate in physical and mathematical sciences. After this she pursued her investigations in the laboratory of M. Lippmann at the Sorbonne. Then came her marriage to M. Curie, and from that time Madame associated herself with her husband's professorial work. In 1903 Madame Curie was awarded the diploma of Doctor of Science by the Faculty of Sciences of Paris. Since then she has been professor at the Higher Normal School for Girls at Sèvres, near Paris, where she lectures on Physics. Meantime, she has published memoirs on "The Magnetic Properties of Tempered Steels" and "On Radio-Active Substances," the latter of which she presented as her thesis to the Faculty of Sciences to obtain her diploma of Doctor.

Professor and Madame Curie.

The home of M. and Mme. Curie was located on the boundary of Paris. At the back of the house a laboratory had been erected where, when not engaged on professional duties, they carried on their scientific investigations.

It is always interesting to trace the history of a great scientific discovery. The discovery of radium has revolu-

tionised physical and chemical theories. It has destroyed the belief in the indestructibility of the atom, a belief which has been a firm article of faith with chemists and physicists for a century. It has realised the dream of the alchemists in the transmutation of metals.

The Lashkar Electrical Installation: Erecting the Chimney.

By what steps were M. and Mme. Curie led to this unique discovery which had escaped the search of the ever-increasing army of keen investigators who had been working in the laboratories of every civilised country for more than 50 years? This discovery, remarkable as it is, did not spring fully equipped from the brains of its authors, but was led up to by a series of steps prepared by previous investigators.

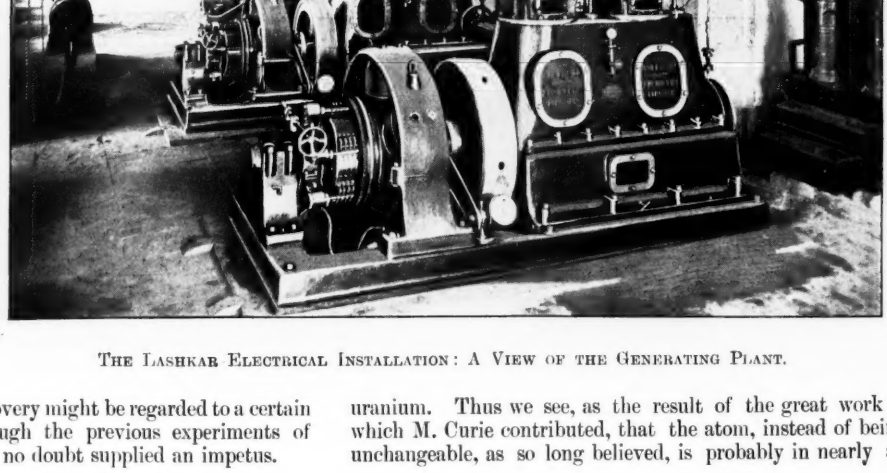
The starting point of the rapid series of discoveries which culminated in the discovery of radium and other radio-active substances, may be taken to be the discovery of the X-rays by Röntgen. This great discovery might be regarded to a certain extent as accidental, though the previous experiments of Lenard with cathode rays, no doubt supplied an impetus.

Röntgen's discovery led to a search for natural substances which might emit X-rays, and since the production of X-rays in the tube appeared to be always accompanied by phosphorescence, the phosphorescent substances were carefully examined. Becquerel, among others, discovered that certain phosphorescent substances were capable of affecting a photographic plate through dark paper. Amongst the substances tested by Becquerel was uranium, and further experiment showed that all compounds of uranium, as well as the metal itself, possessed this property, whether phosphorescent or not.

Mme. Curie examined a large number of minerals in order to discover whether any of them possessed the radioactive properties of uranium and its compounds. A considerable number containing uranium and thorium were found to be radioactive. Their radioactivity was carefully measured by the electrical method, and the curious discovery was made that pitchblende, a uranium mineral, was more radio-active than uranium itself. This suggested to M. and Mme. Curie the possibility of there being in the pitchblende another element much more radio-active than uranium.

By a laborious process of chemical treatment, M. and Mme. Curie succeeded in separating from pitchblende two powerfully radio-active substances, one of which in the pure state was a million times more active than uranium. One of these substances was named polonium, in honour of Mme. Curie's native country, and the other radium.

The remarkable work of M. and Mme. Curie has created a new science—the science of radio-activity—which has already made most remarkable progress. The combination of accurate measurement and applied mathematics characteristic of the Cambridge School of Physicists in this country has contributed greatly to that result. We now know, for example, that radium undergoes seven successive changes, each representing a chemically different material, before the final product is reached. There is strong reason for believing that this final product is the second radio-active element, polonium, discovered by the Curies. Radium itself is strongly suspected of being a radio-active product of uranium. Thus we see, as the result of the great work to which M. Curie contributed, that the atom, instead of being unchangeable, as so long believed, is probably in nearly all



The Lashkar Electrical Installation: A View of the Generating Plant.

substances undergoing a more or less rapid disintegration. Twenty years ago, so rapid is now the progress of scientific discovery, this would have been inconceivable. The unfortunate death in the prime of life of the scientist who was the pioneer in this field, will ever remain one of the most tragic events in the history of science.

THE ELECTRIC LIGHTING OF LASHKAR CITY, GWALIOR, CENTRAL INDIA.

It was after the Coronation Durbar, held at Delhi on January 1st, 1903, where electricity as an illuminant was, for the first time in India, used on a large scale in the magnificent camps of the Viceroy and native chiefs assembled to do honour to the King-Emperor, that the Maharajah of Gwalior determined to give the people of his capital the advantage of a well-lighted city. The Maharajah, who is nothing if not practical, seeing that a demand existed for a public supply called a public meeting at which it was decided that the municipality should lay down plant to light the streets and provide energy for the public in certain parts of the city. The municipality, having no funds of their own for the purpose, obtained a loan for 20 years at 4 per cent. from the Maharajah. Tenders were accordingly invited and the contract for the entire installation was eventually placed with Messrs. Balmer, Lawrie and Co., of Calcutta, by whom the work has been successfully carried out.

Lashkar City: Views of the Cable Laying, Overhead Transmission and Street Lighting.

The system adopted is three-wire continuous current with 450 volts across the outers: most of the mains are of bare copper carried overhead on tubular steel poles, the exceptions being 2,000 yds. of Johnson & Phillips's 3-5 triple concentric cable used as a feeder to a portion of the city, and two other short lengths where the streets are too narrow and tortuous to allow of overhead wires being used. These underground mains are laid on the solid system in earthenware troughing filled in with bitumen.

The principal streets are lighted with 30 Johnson and Phillips's enclosed Ark lamps, placed 100 yds. apart and wired five in series across the outers, while the less important streets are lighted with about 200 ½-ampere Nernst lamps of the Kingsway type, spaced at intervals of from 50 to 100 yds. apart, according to the nature of the thoroughfare. These streets were formerly lighted by means of oil lamps placed on pillars of locally hewn stone, and the accompanying views aptly illustrate the contrast between the old and new methods of lighting.

In all, about 10 miles of streets have been lighted electrically, in most of which distributing mains for a public supply have also been laid. It is worthy of note that for the Nernst lamps separate mains have been run from the feeding points, so that they will be unaffected as far as possible, by variation in voltage due to fluctuations in the public supply load.

The Maharajah's palace already possessed an installation supplied at 110 volts from two Belliss-Parker 32½-KW. direct-coupled sets with a small storage battery, and in view of the inconvenience and expense that would have been entailed by a change of pressure it was decided to replace the Belliss engines by two 50-H.P. motors, working at 450 volts pressure and leaving the existing installation otherwise intact.

The two Belliss engines are now running at the generating station, where, coupled to new dynamos, they are used at times of light load.

The generating station is a handsome building of local stone, appropriately situated on the site of a disused gas works, this being in the most central situation available. The building consists of an engine room 100 ft. × 26 ft., boiler room 100 ft × 37 ft., workshops, offices, and a room suitable for the accommodation of a storage battery should the latter subsequently be installed. The chimney is of mild steel supported on a masonry plinth, and has a total height of 120 ft.

The architect responsible for the design of the building was H. E. Prince Bulwant Rao Scindhia, brother to the present Maharajah.

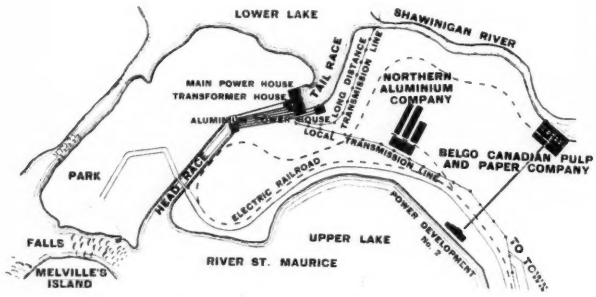
In the engine room are installed two Robey 12 in. × 22 in. × 9 in. enclosed forced lubrication engines running at 460 revs. per minute, coupled direct to two Johnson and Phillips's six-pole shunt-wound dynamos of a capacity of 120-KW. each at 500 volts pressure.

The engine room also contains the two Belliss-Johnson and Phillips' sets mentioned above, and two 36-KW. balancers, the total capacity of the plant being 305 KW., and sufficient space has been left to allow of the installation of another 300-KW. set for extensions.

A five-ton travelling crane of Herbert Morris & Bastert's standard type, traverses the entire length of the engine room.

The switchboard, which is fixed on a low gallery at one end of the room, consists of four dynamo panels, two balancer panels, an arc lighting panel and six feeder panels: the panels are of white marble mounted on the usual angle iron frame work, the whole being kept as fire proof as possible.

The boiler house contains two Babcock & Wilcox boilers each of 1,126 sq. ft. heating surface, which supply steam to the two large generators, and two Marshall locomotive



Plan of the Shawinigan Power Development.

boilers, the latter having been brought from the Palace, where they formed a portion of the original installation.

For boiler feeding, two Cameron type fly-wheel pumps have been installed together with two feed water heaters, through which a portion of the exhaust steam passes. In the boiler room, flues and chimney, provision has been made for extensions of the plant up to a total capacity of 600 KW.

The overhead mains are taken through the boiler house into the engine room, each lead being provided with a choking coil and a magnetic blow-out lightning arrester. Horn type lightning arresters have also been fitted at intervals throughout the network, with magnetic blow-out arresters at the feeding points. In India violent thunderstorms are of frequent occurrence during the monsoons, it is therefore necessary to take every precaution against damage by lightning, so further lightning arresters have been fitted on the switchboard and each generator is protected by two choking coils.

The plant was started to work in December last, and the installation was formally inaugurated by H.R.H. The Prince of Wales during his recent visit to Gwalior. This ceremony was performed at dusk, His Royal Highness switching on the lights through the medium of a relay switch actuated by a press-button concealed in the howdah of a silver elephant, which was provided by the contractors as a memento of the occasion and subsequently presented to the Prince.

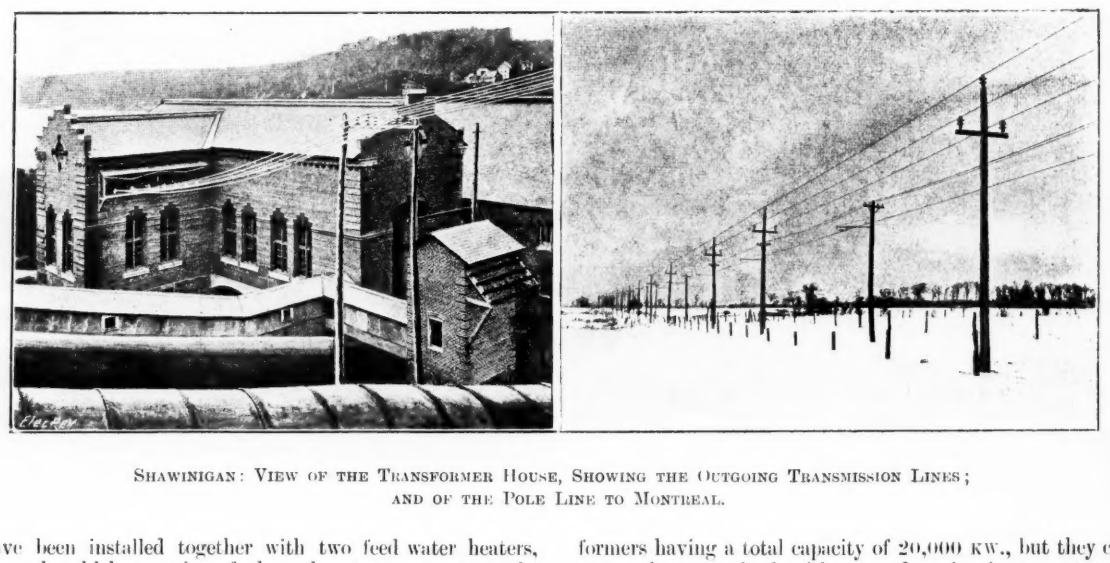
Since the inauguration the plant has been working without a hitch, and it is hoped that before long extensions will be required. At present the equivalent of 4,650 8-C.P. lamps are connected, and although current is supplied at the comparatively low rate of 4 annas (equals 4d.) per unit, the undertaking gives every indication of proving a financial success.

It only remains to add that the scheme was carried out under the direction of Mr. F. M. Short, chief electrical engineer to Messrs. Balmer, Lawrie & Co., and under the immediate supervision of Mr. W. Hodgkinson, who was responsible for the erection of the entire installation, being assisted in the latter work by Mr. R. W. McClay, both these gentlemen also being on the electrical staff of the above-mentioned firm.

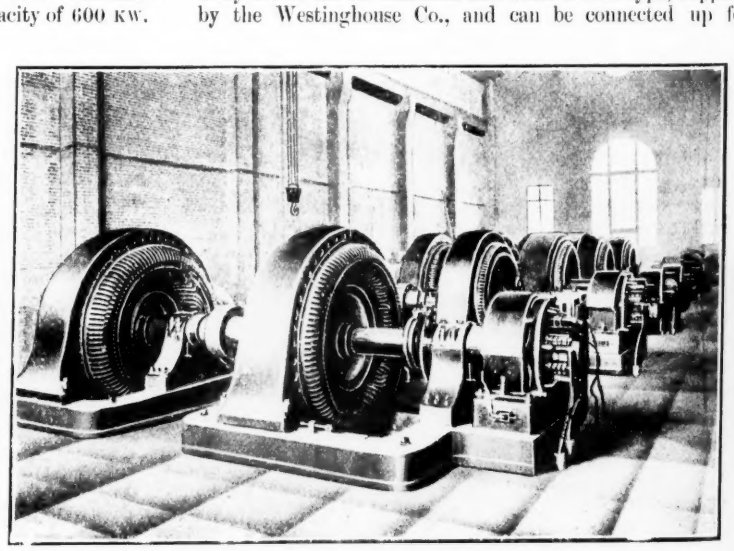
THE SHAWINIGAN WATER AND POWER CO.

(*Concluded from page* 476.)

The transformer house runs parallel with the power station and is a similarly fireproof building. It contains 14 transformers having a total capacity of 20,000 KW., but they can carry a large overload without undue rise in temperature. They are of the oil-insulated and water-cooled type, supplied by the Westinghouse Co., and can be connected up for



Shawinigan: View of the Transformer House, Showing the Outgoing Transmission Lines; and of the Pole Line to Montreal.



Shawinigan: Motor-Generators at the Montreal Terminal Station.

12,500, 25,000, or 50,000 volts. Each transformer underwent a test of 100,000 volts before leaving the Westinghouse works: the base of each is fitted with a 6-in. water-pipe, so that in case of a transformer breaking down and getting on

fire, water can be admitted at the bottom, forcing the oil up and away through a discharge pipe that is fitted in the top, but the admittance of water would only be resorted to as a last extremity.

Each transformer has two sets of rails which form part of the bedplate, the rails resting on two sets of flanged wheels which form part of a truck upon which the whole transformer rests, the truck being securely bolted to the ground. Along the centre of the transformer house is a track built into the floor and provided with a truck which has two lines of wheels set to the same gauge as those on which the transformers rest. By this means, when it is necessary to remove a transformer for repairs, it is easy to draw it on to the movable truck and down to one end of the building, where a means for dismantling is provided, there being no crane in the transformer house.

The H.T. leads of the transformers pass through the lid by way of mica stuffing boxes and then through a long knife break switch to the H.T. bus-bars, which are run along the top of the building on insulators; each insulator was subjected to a test of 120,000 volts before use. The long knife-break switch is the only switching arrangement on the H.T. side, and is used for connecting or disconnecting a transformer.

From the H.T. bus-bars the Montreal lines are led through static interrupters and lightning arresters, and then out of the building through sewer tiles 20 in. diameter, which are closed by glass plates pierced in the centre to carry the conductors. Each line consists of three aluminium stranded cables of about ·14 sq. in. area, carried on wooden poles. The cables are triangularly disposed, the distance from cable to cable being 60 in. At times of peak load the difference of potential between these cables is 60,000 volts. The transmission loss of each line when carrying full load and at unity power factor is 12 per cent.

In spite of the great distance and exposed condition of the overhead lines, the system is remarkably free from stoppages, and we understand that the lines have never been the cause of damage to either life or property. In the case of a line being short circuited, the operator locates the faulty line and disconnects it; immediate attention to this prevents interference with the rest of the supply; an "earth" is cleared by the oil-break switches which are joined up to open automatically.

The Montreal transmission line is about 90 miles in length, and runs along the Great Northern and Chateauguay and Northern Railway tracks to the company's terminal station in Montreal.

The power line is transposed twice in its entire length, each transposition being one-third of a complete turn.

The terminal station contains an equipment of step-down transformers and motor-generators, the latter consisting of 30-cycle, three-phase synchronous motors, direct-coupled to 60-cycle, two-phase generators (in 1,200 H.P. units), from which energy is delivered to the Montreal Light, Heat and Power Co. for distribution in the City of Montreal.

From the main transmission line at Poliette, a point some 35 miles from Montreal, a branch line leads from a step-down transformer station, and by a submarine three-core cable under the St. Lawrence River to the City of Sorel for local distribution. The transmission pressure is 12,500 volts.

In addition to the power station, the Shawinigan Water and Power Co., having the sole right to the water-power of the Falls, supply the Northern Aluminium Co. with the equivalent of 12,000 H.P. through a 12-ft. penstock for the manufacture of aluminium, the Aluminium Co. having their own direct current machines for this purpose. The Belgo-Canadian Pulp Co. take a similar amount for the manufacture of paper and pulp.

Motor-Driven Testing Plant.—In order correctly to measure the power supplied to pumps for doing work under various conditions, and to obtain the exact efficiency of the plant before installation, Messrs. Hathorn, Davy & Co., Ltd., of Leeds, have recently installed at their works a large testing plant, driven by a 100-H.P. Westinghouse motor, the speed of which is variable from 800 to 1,500 r.p.m.

PARLIAMENTARY.

London Tramway Schemes.

Sir Wm. McIver's Select Committee of the House of Commons sat on Wednesday to consider the London County Council Bill, the Blackfriars Bridge Bill, the Middlesex County Council Tramways Bill and the London United Tramway Co.'s Bill. The London County Council, whose Bill was the first on the list, was represented by Mr. Ernest Pollock, K.C., Mr. Moon, K.C., Mr. Du Cane and Mr. L. Macassey. There were a large number of opponents, including the London and India Dock Co., represented by Mr. Balfour Browne, K.C.; the Middlesex County Council, represented by Mr. H. Lloyd, K.C.; Hampstead Borough Council, represented by the Hon. J. C. Fitzgerald, K.C.; Lambeth Borough Council, represented by Mr. C. Monro; London Omnibus Owners, represented by Mr. Coward, K.C.; the Metropolitan District Railway Co., London and North-Western Railway, Wandsworth Borough Council, Islington Borough Council and others.

Mr. Pollock said the Bill of the London County Council provided for tramways and improvements in various parts of the county and for the convenience of all parties, he suggested that he should open the case with regard to the scheme for carrying tramways over Westminster Bridge, along the Victoria Embankment and over Blackfriars Bridge. The construction of the Blackfriars Bridge tramways was proposed in the second Bill which was being promoted by the Corporation of the City of London. He suggested that after he had opened the first part of the Bill, then the Committee should consider the City Corporation Bill.

Sir Ralph Littler, K.C., on behalf of the City of London Corporation, pointed out that last year a scheme was sanctioned by a Parliamentary Committee to carry tramways over Blackfriars Bridge as it now existed, but that had been thrown out, and the City was now prepared to construct the tramways and lease them to the London County Council.

Mr. Coward said that he represented all the omnibus companies of London, and he wanted to raise the question as to how far it was wise and politic, in view of the great development which had taken place in motor-omnibuses, to construct tramways on a large scale.

The Chairman said the Committee would see that Mr. Coward got his opportunity.

Mr. Erskine Pollock, K.C., then opened the case for the London County Council. He said that by the Tramways Act of 1870 the Metropolitan Board of Works was constituted the tramway authority for London, and when the County Council came into being the powers were taken over by them. But although the Council had been the tramway authority for many years, it was not until 1896 that they had power to work their tramways. Of the whole of the tramways in the county the Council worked 103 miles 3 furlongs, and the remaining 15 to 18 miles would be owned and worked by the Council by the year 1911, when the Council would have become owner of the tramway system for the whole of London. Anyone looking at a map of the London tramways would notice that there were two systems, north and south, and that they were sundered by the River Thames. The present Bill sought to connect up these two systems by carrying the tramways over two of the bridges, Blackfriars and Westminster, by taking the tramways along the Embankment and by connecting them there with the subway which was already partly constructed, and was authorised as far as the Embankment. The question of taking the trams across the bridges had been before the Royal Commission on London Traffic, the Advisory Board of Engineers having stated in their report that the cross-shunting of the trams at Westminster terminus was responsible for great delay. With regard to Westminster Bridge, it was a modern bridge (opened in 1862); it was 810 ft. long, its width being something like 120 to 94 ft. The width of the carriage way was 54 ft. 6 in. In one respect the scheme before the Committee differed from the scheme of last year. The present proposal was to take the trams over the bridge on the down-stream side. This, it would be seen, would be a very great improvement, as it would enable the trams to be slewed round on to the Embankment without in any way interfering with the other traffic. The same thing applied to the Embankment and to Blackfriars Bridge. On the Embankment the lines would be placed on the water side of the roadway, and on Blackfrairs Bridge on the western side of the bridge. The distance of the nearest rail from the kerb of the Embankment would be 2 ft. 6 in.; and since there would be no setting down of passengers, or at least very little, on the Embankment itself, or in the middle of the bridges, the trams would be continually on the move, and would be no obstruction to traffic. On the question of the junction with the subway, the proposal was to bring the subway out on to the Embankment at the spot where the western steps of Waterloo Bridge were. These steps were very little used, and there was a similar access on the eastern side of the bridge The cost of the proposed lines, which would, of course, be on the conduit system, would be £85,900, which included the junction lines with the subway. There was no public body opposing the scheme, and this year there was no opposition from the Home Office. The only opposition was by the omnibus companies and the owners, lessees, &c., on the line of route. Counsel then dealt with these petitions at length.

Mr. Maurice Fitzmaurice, chief engineer to the L.C.C., was then called, and in the course of his evidence, said that the proposed route was the same as that approved by Mr. Kearley's Committee last year. With regard to the shallow subway, he said that it was proposed to run a through service of single-deck cars, as the double-deckers would not go into the subway.

Cross-examined: A half-minute service of cars would mean that the cars would be some 100 yards apart, but he did not think that that would interfere with the traffic. He knew nothing about the takings of the motor-omnibuses; he thought everyone would like to know.

The Committee adjourned.

In the House of Commons on Tuesday, April 24th, the Macclesfield and District Tramways Bill was considered and ordered for third reading.

The following was read a second time:—Romford and District Tramways Bill.

NOTES.

Wolfram (Tungsten) Lamps.—The members of the Purchasing Association of Austro-Hungarian Electricity Works, which is a co-operative society for the buying of lamps for sale to the customers of the supply works forming the Association, met recently at Vienna, when a report was presented by Herr F. Ross, of Vienna, on the development of low watt metallic filament lamps, of which the Wolfram lamp is the latest example as devised by several different inventors. An abstract of the report appears in the *Elektrotechnische Zeitschrift* of April 12th.

It is pointed out that the employment of wolfram as a filament for electric glow lamps originated from the first patent application which was made by Dr. Just on April 14th, 1903. The process is so arranged that a carbon filament in the vapour of oxyhalogen combinations of wolfram or molybdenum in the presence of a little free hydrogen is brought to a high temperature by means of the electric current, and in this way the carbon is replaced by wolfram or molybdenum. This method, which essentially represents a transfer of the idea of Dr. Blau to other metals which are difficult of fusion, seems to have met with great difficulties in being practically carried out, as information as to lamps made according to this process of substitution has hitherto not been published.

Another process forms the subject of a patent application made by Dr. Just, on February 3rd, 1905. In this case, the inventor by the use of hydrogen produces a plastic paste from compounds reducible to metal (oxides, sulphides and chlorides) of the above-mentioned metals in powder form, with a binding material free from carbon, such as water or other liquids vaporising without residual. The paste is pressed into the shape of the illuminating body, and heated in a hydrogenous atmosphere until the reduction takes place. The product thus obtained is either directly employed as a filament or after it has been subjected to a drawing process.

An entirely different method is advanced by Dr. Kuzel. He employs colloidal solutions of highly fusing metals, and the paste process known by the work of Auer von Welsbach. The Auer Co. (Incandescent Gas Light) has also extended its experiments to molybdenum and wolfram, and applied for a patent in Austria on March 15th, 1906. In this process the trioxide, or hydrated acid, of the above metals is pulverised with excess ammonia until a viscous paste is formed, which is worked up into filaments in the known manner.

The article in our contemporary proceeds to state that it will be seen that various inventors are working on the production of the wolfram filament. Herr Ross, however, expressly emphasises that, so far as he is aware, none of the applications for patents—with the exception of the first application of Dr. Just—have been granted in countries where a preliminary examination as to novelty takes place, and particularly in Germany and Austria. It can therefore not at present be seen which of the various processes will receive actual protection by patent, or which method will yield useful lamps for practical use. The lamps produced according to Dr. Just's process have hitherto only been praised by the daily newspapers; but those made on the Kuzel method have been tested in the Technological Trade Museum with good results. The lamps in question were for about 30 volts, and it remains to be seen whether lamps of from 100 to 120 volts can be produced on the same process without difficulties arising.

The testing station of the Vienna municipal electricity works has hitherto only had wolfram lamps of the Auer Co. placed at its disposal for investigation. The tests of these lamps have not yet been completed, although the results hitherto obtained with about 1,000 hours of lighting are regarded as favourable. One-watt lamps, for which pressures of from 100 to 120 volts first came into consideration, have only been rendered available by the Auer Co. The sitting-hall was also lighted with such lamps of from 60 to 80 candles, which yielded a pleasant light owing to its beautiful white colour. That such lamps are able to bear a considerable over pressure was shown by Herr Ross in a test in which a lamp was alight at twice the working pressure. In conclusion, it is submitted that a fundamental trial under the conditions of practice will first show whether the far-reaching expectations placed on the the new metallic filament lamps will be fulfilled, and that the testing stations of the purchasing associations of electricity works in the various countries come first into consideration in this connection.

The title of the company, to which reference was made in this journal on March 30th, is the Wolfram Lampen Actien Gesellschaft, of Augsburg. It has been formed with a capital of £42,500 for the working of the Just-Hanaman patents for incandescent filaments. The holders of the world's patents receive £20,000 in cash, and £20,000 in shares. The board of supervision comprises Dr. Genssler and Herr Schwarz, of Munich, and Herr Siegfried Landesberger, of Vienna, while the president is Dr. Otto Goll, chemist.

The Production of Red Rays in the Mercury Vapour Lamp.—It is well known that the mercury vapour lamps recently introduced commercially, give a spectrum containing no red rays and consequently differing essentially from all the other artificial lights. The difference is especially noticeable when viewing objects which are red by daylight. Thus red sealing wax appears chocolate brown, the human skin receives a blue-green tinge, and so on. It is this defect chiefly which has hitherto hindered the widespread use of the mercury lamp, and numerous experimental attempts have been made to cure it. These include the use of substances having a red fluorescence, and also the combination of ordinary incandescent lamps with mercury vapour lamps, but such attempts have not proved successful. Messrs. E. Gehrcke and O. von Baeyer have recently made some further experiments in this direction at the Reichsanstalt, Charlottenburg. These consisted in modifying the working material of the lamp by employing amalgams in place of pure mercury. If a tube of amorphous quartz is used with electrodes of an amalgam of 100 parts of zinc with 30 parts of mercury by weight, it is found that besides the ordinary mercury lines: 435·9, 546·1, 576·9, 579, there are also strong zinc lines present in the spectrum, viz.: 468, 472·2, 481·1 and 636·4 U. The red zinc line, 636·4, is especially prominent, and the light of such a lamp (run-off 110 volts, with a steadying resistance) approximates much more closely to natural daylight than that of the ordinary mercury lamp does. Red sealing wax appears red, and the human skin appears, if anything, rather too rosy. Only the yellow effects remain distorted, and appear either too ruddy or two green. To correct this last effect, a little of the metal sodium was added to the zinc amalgam, and the result was then very satisfactory, the light given being similar to that of many Bremer flame lamps. The zinc amalgam is solid at ordinary temperatures, and clings to the surface of the tube; and in order to avoid cracking the latter through excessive expansion of the amalgam, it was further found advantageous to add about 10 per cent. of bismuth. The presence of the bismuth did not appreciably affect the colour of the light. The length of arc employed in these experiments was about 10 cm. No photometric tests have been made as yet.—*Elcctrotcchnische Zeitschrift.*

Fatality.—A telephone wireman employed by the National Telephone Co., fell from the top of a 50 ft. pole in Wenlock Street, City Road, on 9th inst., and was killed.

Cross Talk on the Telephone Lines.—A parrot was the cause of considerable interruption to the telephone service of Cape Town a few days ago. The bird had in some way managed to become entangled in a bed of telephone wires crossing St. George's Street, and its efforts to liberate itself only resulted in further complications. Eventually the services of two G.P.O. linesmen were requisitioned, and after a little skilful manœuvring they succeeded in restoring order out of chaos. The cause of the commotion was by this time in a state of collapse, as at least two wires had been tightly twisted round his neck, but he managed to flutter safely into the street, where he was promptly captured. We believe that there was a considerable amount of "cross talk" during these operations, although the parrot was, strange to say, singularly uncommunicative, probably owing to the pressure on his vocal organs.

Patent Specification 3,653—1902.—This is the patent which figures in the prospectus of "The London Electrobus Co., Ltd." It is for "Improvements in motor road vehicles," and is "a communication from abroad by La Compagnie Française de Voitures Electromobiles of Paris, France, Manufacturers." It is granted to G. B. Ellis, of the firm of Mewburn, Ellis & Pryor, chartered patent agents, of 70 and 72, Chancery Lane. The date of application is February 12th, 1902; that of the complete specification November 11th, 1902, and the acceptance January 8th, 1903. The patent is for driving gear, and the five claims read as follows:—

1. In a motor vehicle wherein the rear axle is driven through the medium of differential gearing, the employment of a continuous or uninterrupted rotating rear axle, the differential gear being so disposed with reference thereto as not to interrupt the continuity of the rear axle, substantially as described.

2. In a motor vehicle wherein the rear axle is driven through the medium of a shaft passing from front to rear of the vehicle, the interposition in said shaft, or between said shaft and the rear axle of a sliding coupling or connection such as O.P.Q.R., for the purpose specified, substantially as described with reference to the accompanying drawings.

3. A motor vehicle wherein the real axle is driven through the medium of a shaft passing from front to rear of the vehicle, said shaft having two Cardan joints at suitable parts of its length, and a sliding coupling such as O.P.Q.R., interposed in said shaft or between said shaft and the rear axle, substantially as described with reference to the annexed drawings.

4. The improvements in motor vehicles comprising the combination of the sliding driving connection and Cardan joints for the shaft, the special construction of differential gear with axles and sleeve for the vehicle wheels, all constructed, arranged and adapted to operate substantially as and for the purpose set forth.

5. A motor vehicle constructed, arranged and adapted for operation substantially as described with reference to the annexed drawings.

In the body of the specification we notice the following allusion to the motor as "already patented by my foreign correspondents, and which has two equal windings whereby different speeds can be obtained without loss of energy by connecting up said windings in series or parallel as required." To this we refer on page 687.

It will be observed from the foregoing that the patent upon which the company stakes its claim to a "monopoly" merely covers a particular form of gear. We have no hesitation whatever in stating that the success of electric road traction in no way depends upon the adoption of any special type of gear—there are other and well-known gears which will do all that is required. We repeat that the life of the battery is the crux of the whole question.

Appointments Vacant.—Assistant engineer (£130), traffic superintendent (£130), assistant inspectors, car-shed foreman, clerk, and others, for the Burton and Ashby Light Railways; junior shift engineer for Crewe (£80); electrical engineer for Clydebank Dock; engineer-in-charge for Paisley electricity works (35s.); electrical foreman for India.

Electro-Medical Congress at Milan.—The third International Congress of Medical Electrology and Radiology will be held at Milan, September 5th to 9th, 1906, under the presidency of Prof. Camillo Bozzolo, of Turin University. Members who wish to take part should communicate with the secretary of the organising committee, M. Doumer, 57, Rue Nicolas Leblanc, Lille, before August 15th. Dr. Herschell, 36, Harley Street, London, W., will receive the subscriptions of members.

Technical College, Finsbury, Old Students' Association.—A meeting of old students, at which Sir Owen Roberts, M.A., D.C.L., J.P., has kindly consented to preside, will be held at the Technical College, Finsbury, on May 8th, at 6 p.m. Any old student who has not received a notice of this meeting is invited to attend.

Institution Notes.—Institution of Civil Engineers.—At the annual general meeting of the Institution on Tuesday evening, Sir Alexander Binnie, President, in the chair, the result of the ballot for the election of officers was declared as follows:—President, Sir Alexander B. W. Kennedy, LL.D., F.R.S.; Vice-Presidents, Mr. W. R. Galbraith, Mr. William Matthews, C.M.G., Sir E. Leader Williams and Mr. J. C. Inglis; other members of Council, Lieut.-Col. W. P. Anderson (Ottawa, Canada); Mr. B. Hall Blyth (Edinburgh); Mr. John Benton, C.I.E. (India); Mr. C. A. Brereton, Mr. R. Elliot-Cooper, Col. R. E. B. Crompton, C.B., Mr. Joseph Davis (Sydney, N.S.W.); Dr. G. F. Deacon, Dr. Francis Elgar, F.R.S., Mr. M. Fitzmaurice, C.M.G., Mr. R. A. Hadfield (Sheffield); Mr. G. H. Hill, Mr. Walter Hunter, Mr. J. H. Johns (Johannesburg); Mr. G. R. Jebb (Birmingham); Sir William T. Lewis, Bart. (Aberdare); Sir George Livesey, Mr. A. G. Lyster (Liverpool); Sir Andrew Noble, Bart., K.C.B. (Newcastle-on-Tyne); the Hon. C. A. Parsons, C.B., F.R.S. (Wylam-on-Tyne); Mr. A. Ross, Mr. A. Siemens, Mr. J. Strain (Glasgow), Sir John I. Thornycroft, LL.D., F.R.S., Prof. W. C. Unwin, B.Sc., F.R.S., Mr. A. F. Yarrow.

The Council has made the following awards for Papers read and discussed before the Institution during the past session:—A Telford gold medal to Mr. J. A. Saner, a Watt gold medal to Mr. G. G. Stoney, and a George Stephenson gold medal to Dr. I. E. Stanton; Telford premiums to Mr. Leonard Bairstow, Mr. H. S. Bidwell, Mr. J. J. Webster, Mr. Cathcart W. Methven, Mr. H. A. Mavor, Sir Frederick R. Upcott, K.C.V.O., C.S.I., and a Manby premium to Mr. D. E. Lloyd-Davies. The presentation of these awards, together with those for papers which have not been subject to discussion and will be announced later, will take place at the inaugural meeting of next session.

London Power Supply.—The *Times* says that the Hybrid Committee held their first meeting on Wednesday. Mr. Luke White was appointed chairman. More than 50 petitions have been lodged in connection with the L.C.C. Bill. The Committee will meet again next Tuesday in the large conference room contiguous to Westminster Hall.

The Cologne-Bonn Circular Railway.—Travellers who have visited Cologne, and recollect its "Rundgang" system of tramways, will not be surprised to notice that Cologne and Bonn will shortly be connected by a circular electric railway. As it is an example of high-tension direct-current work, we take a few particulars regarding it from an article, "Electrische Bahnen und Fahrzeuge," in the *Electrotechnische Zeitschrift* for March 29th, 1906.

The total distance between Cologne and Bonn is 28·3 kilometres. About midway at Wesseling (on the Rhine) the main power station is erected. About here also there are wharves on the Rhine, and a considerable carrying trade in brown coal and briquettes is done The passenger cars are to run at 80 kilometres per hour, two per hour in each direction, and each train will consist of four cars, or 250 seats. The "ranchers" occupy the central portions of these carriages.

At both Bonn and Cologne the town's supply voltage is 550, and the voltage to be used on the portion of the line clear of these towns is 990. The work is being carried out by the Siemens-Schuckertwerke Co.

It is noticeable that one firm proposed a single-phase system, the line voltage to be 6,000. A rotary converter was to be used to transform this to continuous current at a suitable voltage for the car-motor, and at the town ends the motor would work direct at 550 volts. However, this scheme was rejected on the ground of the greatly increased weight, loss of economy in working, and to the fact that the distance—22 kilometres—was too short to enable any great advantage to be reaped from the greatly increased line voltage.

The system adopted, then, is 990 for the line and 550 for towns at the ends. This line system is divided into three parts; on two of these there is a battery with boosting arrangement, the central portion being supplied from the power station direct at Wesseling. In the main power station there are two 330-kw. steam generators. The overhead system is used, the current being conducted to the driving cars by means of two sliding-bow trolleys from two wires slung pendulum fashion. This enables a good contact at high speed to be obtained. Each trolley wire is 80 mm. in cross section.

The equipment of the driving car consists of two motors, each of 130 h.p., with series-parallel switchgear. The motors have four series poles and four auxiliary poles, the latter being massive, and slotted centrally to eliminate eddies. The armature windings are bars in open slots, wedged with paraffined wood, which closes the slots. The core is ventilated by ducts, and the commutator has two sets of brushes, and runs sparklessly at all loads.

The speed of the motor is 750 r.p.m., gearing ratio 1 : 3·1, driving wheel diameter 95 cm., and gauge 143·5 cm. Total pull 54 tons, at a speed of about 70 km. per hour.

The car is fitted with Westinghouse pneumatic brakes, a motor-pump being fixed in each car, and the lighting and heating are effected electrically. All switch apparatus is placed underneath the car.

Tramway Repairs May Wait.—A note from Cape Town says that a driver in the employ of the Electric Tramway Co. was summoned in the Assistant Magistrate's Court on April 3rd for furiously driving a repair wagon. The engineer in charge of the electrical works of the company said that there was a breakdown on the day in question, and, as there was danger to life, the wagon was being hurried along the streets to the scene of the damage at as great a speed as possible. This had been done for nine years, and no accident had ever happened, nor had the police ever previously complained, and it was regularly the custom for the fire brigades to travel much quicker. The magistrate said that there was no comparison between the fire brigade or the police ambulance and the Tramway Co.'s wagon, and imposed a fine of 5s. as a nominal penalty, saying that the company ought to have been prosecuted long ago.

Correction.—On p. 698 of this issue, column 2, lines 2-3, for "8d. an hour" read "8d. a unit."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Engineers.—On Wednesday last week the staff and workmen of the Thornhill Power Station held a smoking concert at the Savile Hotel, Dewsbury. During the evening Mr. D. E. Giles, who is leaving the staff of the Yorkshire Electric Power Co. to take up a position as engineer-in-charge under the Birmingham Corporation at their Summer Lane Station, was presented with a silver cigarette case and sovereign case. Mr. Herbert A. Fleet, who occupied the chair, made the presentation.

Mr. L. Andrew, junior engineer to the Fulham Electricity undertaking, has been appointed, out of the 39 applicants, as sub-station assistant to the Stoke Newington undertaking.

Mr. N. A. Dunk has resigned his appointment with the Woolwich Borough Council to take up an appointment with the County of London Electric Supply Co., Ltd.

Mr. W. R. Nice, of the Hammersmith Borough Council Electricity Works, has been appointed mains engineer at Dartford.

General.—Stoke Newington Borough Council on Tuesday resolved to give a gratuity of £70 to the borough surveyor for his services in connection with the erection of the electrical transformer station in Edward's Lane.

Dr. W. A. Caspari, late head chemist to the National Physical Laboratory, has commenced practice as a consultant at 7, Idol Lane, E.C.

Mr. E. Barnes, late of the staff of the Manx Electric Railway Co., who is leaving for Canada, has been presented by the staff with a case of mathematical instruments.

Mr. R. B. Mitchell, superintendent of mains, and Mr. R. B. Maccall, chief clerk in the electricity department of the Glasgow Corporation, have each had their salary increased by £25 per annum.

The *Times* of yesterday says that Mr. John Young, the general manager of the Metropolitan District Railway, resigns his position as general manager on May 1st, and is to join the board of directors. Mr. A. Collinson, of the mechanical engineers' department of the North-Eastern Railway, has been appointed to succeed Mr. Young as manager of the District Railway.

Obituary.—The death occurred suddenly, on March 31st, in Marion, Philadelphia, of George Martin Brill, president of the J. G. Brill Co. Apoplexy was the cause of death.

Mr. John Thornton, founder and head of the firm of Thornton and Crebbin, makers of electric lighting central condensing plant, Bradford, died on April 18th, in his 67th year.

A Calcutta paper says that Mr. Chard, electrical engineer, of Messrs. John & Co.'s spinning mills, has died at Agra, of smallpox.

The *Times* "Deaths" column contains an intimation of the death on April 19th, at Merthyr Tydvil, Marischal Keith Ernest Frith, aged 30 (formerly of the P. & O. line and Central London Railway, and late of the Dowlais Iron and Engineering Co.), electrical and general engineer.

NEW COMPANIES REGISTERED.

Duchy Development Association, Ltd. (88,362).—This company was registered on April 10th, with a capital of £20,000 in £1 shares, to carry on the business of a power supply company, electricians, electrical, metallurgical, mechanical and chemical engineers, manufacturers of and dealers in apparatus used in connection with the generation, distribution, supply, accumulation and employment of motive power, light, heat or otherwise. The first subscribers (each with one share) are:—E. J. Andrews, 2, Marco Road, Hammersmith, W., accountant; A. H. Goodman, 109, Crampton Street, S.E., clerk; D. S. Whitelaw, 34, Mayfair Avenue, The Drive, Ilford, secretary; W. B. Thomson, 22, Wallwood Road, Leytonstone, manager; D. Fraser, 9, Leander Road, Brixton Hill, S.W., clerk; A. C. Gray, 33, Lyncroft Gardens, West Hampstead, N.W., clerk; and T. Jaap, 22, Speenham Road, Stockwell, S.W., clerk. No initial public issue. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £50; remuneration, £100 each per annum (chairman, £50 extra). Registered office, 89 and 90, Cheapside, E.C.

Rhondda Tramways Co., Ltd. (88,145).—This company was registered on April 14th, with a capital of £200,000 in 200,000 ordinary shares of 5s. each, and 150,000 5½ per cent. cumulative preference shares of £1 each, to adopt an agreement between the Urban District Council of Rhondda of the one part, and the Tramways Development Co., Ltd. (as trustee for this company) of the other part, to enter into agreements with the Rhondda Tramways Construction Syndicate, Ltd., and the National Electric Construction Co., Ltd., relating to management, to construct, equip, work and maintain the tramways authorised by the Rhondda Urban District Council (Tramways, &c.) Act, 1902, or any part thereof, &c. The first subscribers are:—L. B. Schlesinger, 21, Cornhill, E.C., banker, 300 preference shares; J. C. Saunders, Melton Heath, Dorking, director of the Commercial Union Assurance Co., Ltd., 300 preference shares; W. B. Cownie, Queen Anne's Chambers, S.W., chartered accountant, 300 preference shares; B. Bernheim, 41, Lansdowne Road, N., director of National Electric Construction Co., Ltd., 300 preference shares; J. T. Jervis, Queen Anne's Chambers, S.W., civil engineer, 300 preference shares; E. A. Mitchell, Wolstonbery, Carshalton, electrical engineer, one ordinary share; and R. Watson, Queen Anne's Chambers, S.W., one ordinary share. No initial public issue. The number of directors is not to be less than three nor more than seven; the first are: L. B. Schlesinger, J. C. Saunders, W. B. Cownie, B. Bernheim and J. T. Jervis; qualification, £300; remuneration, £200 each per annum (£100 extra for the chairman). Registered office, Queen Anne's Chambers, Westminster, S.W.

Vulcan Dynamo and Motor Co., Ltd. (88,445).—This company was registered on April 18th, with a capital of £6,500 in £1 shares, to adopt agreements (1) with W. R. Saltrick and (2) with W. Geipel and F. M. T. Lange, and to carry on the business of mechanical and electrical engineers and contractors, manufacturers of and dealers in dynamos, lamps, cables, insulating materials and accumulators, &c. The first subscribers (each with one share) are:—H. Chitty, 4, Lloyd's Avenue, Fenchurch Street, E.C., electrical engineer; W. Geipel, 72A, St. Thomas Street, S.E., engineer; F. M. T. Lange 72A, St. Thomas Street, S.E., engineer; D. J. Edmonds, 30, Budge Row, E.C., solicitor; W. R. Saltrick, "Roy Toi," Grove Park, clerk; W. H. E. Godolphin, Ivydene, Cranley Gardens, Wallington, clerk; and A. J. Edmonds, Faircourt, London Road, St. Albans, clerk. No initial public issue. The number of directors is not to be less than three nor more than seven; the permanent directors are H. Chitty, W. Geipel, F. M. T. Lange and D. J. Edmonds; qualification (except permanent directors), 100 ordinary shares; remuneration as fixed by the company. Registered office, 72A, St. Thomas Street, S.E.

Keeler & Co., Ltd. (88,465).—This company was registered on April 20th, with a capital of £5,000 in £1 shares, to acquire the business carried on at 12, New Chesterfield Street, Marylebone, as "Keeler and Co." to adopt an agreement with E. M. Collins, and to manufacture and fix telephones, telegraphs, electric bells, phonographs, electric light and other apparatus, &c. The first subscribers (each with one share) are:—J. Poore, 7, Thayer Street, Manchester Square, W., electrical engineer; E. P. Keeler, 144, Fawe Park Road, Putney, S.W. electrical engineer; A. L. Keeler, 77B, Fawe Park Road, Putney, S.W., florist; A Baldwin, 87, Lordship Park, Stoke Newington, solicitor; E. Scott, 30, High Road, Streatham, solicitor; A. V. Baldwin, 87, Lordship Park, Stoke Newington, solicitor; and G. Satcher, 121, Elsinore Road, Forest Hill, clerk. No initial public issue; the first directors are E. B. Keeler (chairman and manager), J. Poore and A. L. Keeler; qualification, £25; remuneration as fixed by the company. Registered office, 12, New Chesterfield Street, Marylebone.

Helis Cell and Accumulator Co., Ltd. (88,437).—This company was registered on April 18th, with a capital of £1,000 in £1 shares (666 preference), to carry on the business of electrical engineers, manufacturers of and dealers in electrical and mechanical apparatus and goods, &c. The first subscribers (each with one share) are:—A. J. McMillan, 17, Tower Royal, E.C., secretary; R. G. Hall, 29, Roderick Road, Hampstead, N.W., clerk; J. T. Robinson, 29, Beversbrook Road, Tufnell Park, N., clerk; J. Cocking, 46, Geneva Road, Brixton, S.W., clerk; W. B. Parsons, 18, Riviera Drive, Southchurch, Southend-on-Sea, clerk; R. A. Draper, 11, Colfe Road, Forest Hill, S.E., clerk; and H. Barber, 3, Ranelagh Mansions, Hurlingham, S.W., clerk. No initial public issue. The preference shares are to take all the available profits until they have received an amount equal to the capital paid up thereon; afterwards they are to be converted into ordinary shares. The number of directors is not to be less than two nor more than five; the first are J. T. Szek (permanent) and H. Hunt; remuneration as fixed by the company. Registered office, 12, New Oxford Street, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

F. W. Dickinson, Ltd., electrical engineers, Leeds.—A 5 per cent. debenture for £100, dated April 4th, 1906, charged on the company's property, present and future, including uncalled capital, has been registered. Holder: J. Gordon, 19, Bond Street, Leeds.

Northampton Electric Light and Power Co., Ltd. (28,640).—Issue, on March 29th, of a second mortgage debenture for £1,400, part of series created by resolutions of March 6th, 1898, March 8th, 1901, and March 29th, 1906, to secure £10,000, charged on the company's undertaking and property, present and future, including uncalled capital, subject to first mortgage debentures. Holders: Northamptonshire Union Bank, Ltd., Northampton. No trustees. Previously issued of same series: £8,600.

Northampton Electric Light and Power Co., Ltd. (28,640).—This company's annual return was filed on March 12th, when 10 "A" and 61,084 "B" shares had been taken up out of a nominal capital of £100,000 in 10 "A" and 99,990 "B" shares of £1 each. £61,094 has been received. Mortgages and charges: £42,100.

Electrical Instrument Manufacturers, Ltd. (86,187).—£500 5 per cent. debentures, created December 16th, 1905, and dated March 24th, 1906, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. No trustees.

Folkestone Electricity Supply Co., Ltd.—Issue on April 11th of £15,000 4½ per cent. debentures, part of series created by resolutions of April 18th, 1900, August 28th, 1901, May 12th, 1905, and March 14th, 1906, to secure £90,000. Property charged: The company's undertaking and property, present and future. Trustees: G. Spurgen, J.P., Waynflete, Radnor Park Avenue, Folkestone; and W. R. Davies, 10, Moorgate Street, E.C. Previously issued of same series: £75,000.

Buenos Ayres Electric Tramways Co. (1901), Ltd. (71,206).—A trust deed dated March 30th, 1906, to secure £50,000 second or "B" debenture stock, has been registered. Property charged: Concessions granted by the Municipality of Buenos Ayres, dated August 18th, 1898, July 1st, 1902, and September 18th, 1903, certain freehold land at the back of the station buildings, Calle Rivera, Buenos Ayres, and the company's undertaking and property, present and future, including uncalled capital, subject to a prior charge created by a trust deed dated June 8th, 1903, securing £185,000 debenture stock. Trustees: W. Greenwell, 2, Finch Lane, E.C.; and F. C. Tiarks, 145, Leadenhall Street, E.C. The company has power to issue £50,000 further stock ranking *pari passu* with the present issue.

Scottish House-to-House Electricity Co., Ltd. (29,232).—An additional lien for £6,500 and 6 per cent. interest has been endorsed on a charge dated March 31st, 1904. Property charged: The company's undertaking and property, present and future, including the Coatbridge and Airdrie undertakings and uncalled capital. Holders: County of London Electric Supply Co., Ltd., Moorgate Court, E.C.

Premier Electric Lamp Co., Ltd. (Huyton Quarry) (66,327).—Particulars of £3,000 debentures, created by resolutions of March 29th, 1906, charged on the company's undertaking and property, present and future, including uncalled capital, have been filed pursuant to Sec. 14 (4) of the Companies' Act, 1900. No trustees.

Bastian and Partners, Ltd., electric meter manufacturers, London (77,601).—Issue on March 24th of £2,700 10 per cent. debentures, part of series created July 1st, 1905, to secure £4,000, charged on the company's undertaking and property, present and future. No trustees. No previous issue of same series.

Meadows, Teeton & Minshall, Ltd., electrical engineers, Hanley (83,006).—A debenture dated April 4th, 1906, to secure £430, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder, W. Teeton, Stafford Street, Hanley.

Northallerton Electric Light and Power Co., Ltd. (59,301).—This company's annual return was filed on March 26th, when 1,561 ordinary and 1,151 preference shares had been taken up out of a nominal capital of £10,000 in 5,000 ordinary and 5,000 preference shares of £1 each. £1 per share has been called up, resulting in the receipt of £5,712. Mortgages and charges, £5,140.

Londonderry-Moville Electric Railway Syndicate, Ltd. (75,455).—This company's annual return was filed on February 24th, when 6,507 shares had been taken up out of a nominal capital of £10,000 in £1 shares. £1 per share had been called up on 1,507 and £1,425 5s. has been received. £81 15s. remains in arrears. £5,000 is considered as paid on the remaining shares. Mortgages and charges, nil.

General International Wireless Telegraph and Telephone Co., Ltd. (75,277).—A charge, dated April 18th, 1906, to secure £150 and further advances up to £450, has been registered. Property charged: The company's patents. Holder: F. W. Derby, 1-4, Green Dragon Street, St. Andrew's Hill, E.C.

Newcastle-upon-Tyne Electric Supply Co., Ltd. (27,997).—This company's annual return was filed on April 5th, when 75,000 preference, and 75,000 ordinary shares had been taken up out of a nominal capital of £1,000,000 in 100,000 preference, and 100,000 ordinary shares of £5 each. £5 per share has been called up on 64,241 preference, and 67,029 ordinary, resulting in the receipt of £656,350. £93,650 is considered as paid on 10,759 preference, and 7,971 ordinary. Mortgages and charges: £250,000. (The capital was increased from £750,000 to £1,000,000 in March last.)

Smithfield Markets Electric Supply Co., Ltd. (53,354).—This company's annual return was filed on March 9th, when 12,000 shares had been taken up out of a nominal capital of £100,000 in 20,000 shares of £5 each. £60,000 has been received. Mortgages and charges: £58,000.

Westminster Electric Supply Corporation, Ltd. (27,061).—This company's annual return was filed on March 21st, when 110,000 ordinary and 81,279 preference shares had been taken up out of a nominal capital of £2,000,000 in 200,000 ordinary and 200,000 preference shares of £5 each. £5 per share has been called up on 110,000 ordinary and 31,279 preference, and £1 per share on 50,000 preference, resulting in the receipt of £894,291 (? including payments in advance of calls). Mortgages and charges: £250,000.

Chiswick Electricity Supply Corporation, Ltd. (38,854).—This company's annual return, made up to April 12th, 1905, was filed on March 5th, 1906. 59,400 ordinary and 100 founders' shares had been taken up out of a nominal capital of £100,000 in 99,900 ordinary and 100 founders' shares of £1 each. £1 per share has been called up, resulting in the receipt of £59,500. Mortgages and charges: £40,880.

Scarborough Electric Supply Co., Ltd. (37,569).—This company's annual return was filed on March 23rd, when the entire capital of £100,000 in 10,000 shares of £10 had been taken up. £10 per share has been called up on 9,000, and £7 per share on 1,000, resulting in the receipt of £97,000. Mortgages and charges: Nil.

London Electric Supply Corporation, Ltd. (24,957).—This company's annual return was filed on March 20th, when 110,000 ordinary and 59,810 preference shares had been taken up out of a nominal capital of £950,000 in 20,000 ordinary shares of £3 each and 70,000 preference shares of £5 each. £3 per share has been called up on the ordinary and £5 per share on the preference, resulting in the receipt of £632,360, including £160 paid on 160 forfeited shares. Mortgages and charges; £374,395.

India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd. (1,122 C).—A trust deed dated March 27th, to secure £400,000 debentures created March 6th, 1906, has been registered. Property charged: The company's land and premises at Silvertown, E., certain land and premises in Castle Street and Lower Castle Street, Liverpool, and the company's undertaking and property, present and future, including uncalled capital. Trustees: J. S. Cockburn, St. Anton, Foxgrove Road, Beckenham; J. Ferguson, 39, Albion Street, Hyde Park; M. Gray, Lessness Park, Abbey Wood; J. Henderson, 86, Eaton Place, S.W.; and Sir Henry C. Mance, Kt., C.I.E., Old Woodbury, Sandy, Beds.

CITY NOTES.

Electric Omnibus Traction.

We noted in our last issue the "Press view and test" of an electrically propelled omnibus, which had been given the name of "Electrobus." The prospectus of "The London Electrobus Co., Ltd.," has since been issued. The company has been formed to run electric omnibuses for the conveyance of passengers on the streets of the metropolis. The capital is £30,000, composed of 300,000 ordinary shares and 5,000 deferred shares, all of £1 each. The directors may proceed to allotment on the subscription of 50,000 ordinary shares, which shares have been underwritten. Five contracts have been entered into. The first is between the Motor-Car Emporium and the International Motor Traffic Syndicate, whereby the former sells to the latter the right to use and exercise an invention under Letterf Patent No. 3,653, of 1902, as applied to motor-omnibuses and other types of metropolitan stage carriages during the next seven years. The consideration for such sale of such right of user is the sum of £20,000 and the undertaking to purchase 50 motor-omnibus chassis each year during the seven years. The second contract transfers the benefit of the first contract to the company, the consideration for the transfer being £5,000 in deferred shares of the company, with provision for the substitution in certain events of shares or shares and cash in varying proportions for part of the cash consideration. The third contract provides for the payment by the company to the promoter of £8,500 in consideration of the services rendered by him in negotiating and procuring the fourth contract, and to be rendered by him in advertising and circulating the prospectus and generally paying the expenses incidental to the formation of the company. In addition to the receipt of £8,500, the promoter shall have the right to nominate two directors and also the right to subscribe at a premium of 5s. for any shares which may be issued during 18 months after the first general allotment. By the fourth contract the Motor-Car Emporium agrees to sell to the company 300 electric motor-omnibuses at £700 each, undertakes to deliver the same within 12 months if called upon, and gives an option to the company to purchase other electric omnibuses. The fifth contract is an undertaking by the Securities Exchange, Ltd., to underwrite 50,000 ordinary shares for a commission of 5 per cent. in cash.

From these contracts it will be seen that the London Electrobus Co., which may go to allotment on £50,000 of ordinary shares, will have paid away (in addition to the underwriting charges) £28,500 of its ordinary capital on its inception, besides the £5,000 of the second contract, which, however, is in deferred shares. For this sum the company will have been brought into being, and will have acquired certain rights and obligations. What are the rights? The sole and exclusive right to use an invention patented in 1902, the scope of which is not referred to in the prospectus or the agreements as cited. The use is not for the life of the patent, on all or any vehicle, or in all parts of the United Kingdom; but is limited to seven years, to licensed stage carriages, and to a radius of 15 miles from Charing Cross. And what are the obligations which the company also acquires? The obligation to purchase 50 chassis every year for seven years. The fourth agreement as cited in the prospectus indicates an obligation on the Motor-Car Emporium to sell to the company 300 electric omnibuses at £700 each, but does not state that the company agrees to buy them; so that, so far as can be seen from the prospectus, there is no obligation on the company in respect to that contract, though no other consideration is specified.

We do not wish to discuss here the merits of the patent for which the company pays £20,000 for a limited user, but since the vendors have nothing else to sell, and the authors of the prospectus apparently seek to give the impression that the electric propulsion of licensed vehicles will be a sort of monopoly of the Electrobus Co., we will, for purposes of discussion, assume that the invention covered by patent No. 3,653 of 1902 is of an epoch-marking type, and its use essential for commercial purposes. If the necessary payments are duly made, the patent will be in force till 1916. The company's right to use will expire on April 12th, 1913. Assuming further, for purposes of discussion, that the company lives so long, it will be in the position of having established a business which it will only be able to continue by coming to terms with the patentee.

The directors have no doubt carefully considered the effect of the limitation of 15 miles; but, on general principles, it would seem that there might be advantages in investing £20,000 in omnibuses that have no patented contrivances and are privileged to go anywhere rather than to pay that amount for a right which can only be exercised within a certain radius. The drawbacks of such artificial restrictions would seem naturally to occur to business people in the case of a seriously contemplated business enterprise. Incongruities, however, need occasion but little surprise in a document which contains particulars of a contract for the purchase of chassis for seven years ahead, and in the prospectus itself calls special attention to the disadvantages which other companies suffer in being "saddled with" similar contracts extending over the next two years.

"The well-known consulting electrical engineer, Mr. W. J. Crampton" (*vide* prospectus) reported to the directors to the effect that he had made a detailed and practical examination of the electric 'bus; he commended the noiselessness of the gearing, the fact that change of gear was unnecessary, and the efficient mode of control. He also expressed his approval of the estimate of costs, and stated that the maintenance contracts for tires and accumulators with responsible manufacturing firms left nothing to speculation. We are not familiar with the scope and duration of Mr. Crampton's special experience in connection with electrically-driven vehicles, but we know that he was appointed by the directors on the *day previous* to that on which he dated his report. His examination of the details of the 'bus was therefore remarkable for its celerity, if for nothing else. As for the features which he commended, the noiselessness of the electric broughams which have been running about London for some years is familiar to all; we may add that some of these also have a fixed gear ratio, and have two motors, which can be controlled on the series-parallel system just as easily as the double-commutator motor (which was used on the old electric cabs which came to grief in 1899), while the separate driving of the rear wheels gives perfect differential motion. The report, in fact, is equally remarkable for its artlessness and its futility The names of the "responsible manufacturing firms" which have "*offered*" to take upon their shoulders the burden—likely to be a crushing one—of maintaining the tires and batteries at impracticable rates, are not vouchsafed. Are there any contracts for maintenance in existence at all?

The Electrobus possesses no monopoly worthy of consideration, and its prospects are of equal value. When too late, even the lay Press has appreciated these facts, and has delivered its verdict in no doubtful manner.

It was announced yesterday that "owing to the number of applications for shares in the London Electrobus Co. having far exceeded the minimum on which the directors had decided to go to allotment, letters of allotment were duly posted to applicants on Wednesday," although the lists were open till Thursday. The result was that many shareholders, whose eyes had been opened and who desired to withdraw their applications, on the ground of inadequate disclosures in the prospectus, were unable to do so. We understand that they are combining with a view to taking legal action in the matter.

Bath Electric Tramways, Ltd.

Sir Vincent Caillard presided last Friday at the annual meeting held at Winchester House. In moving the adoption of the report, he said the results of the past year's working were satisfactory. In net revenue there was an increase of £2,650 over 1904. Their capital expenditure had, however, gone up by £32,500, but if they set the increase in revenue against the increase of capital expendi

ture, it worked out at a rate of earning of about 8 per cent. per annum, which alone would justify it being incurred. But that was not a fair calculation, as £8,400 of the £32,000 was what might be called unproductive, as it was paid to the Bath Corporation for the reconstruction of the Midland Bridge. When they were running their cars over the bridge they hoped that the expenditure of that £8,400 would pay at least the 8 per cent. If they deducted that item, the return on new capital expenditure was something like 11 per cent. After meeting all charges for repairs and renewals, interest on debentures, dividend on preference shares, they had earned enough to pay 5 per cent. on the ordinary shares, as recommended. They could have proposed a larger dividend, and could even have gone so far as to propose a distribution on the deferred ordinary shares, but it was better policy not to divide up to the hilt, but strengthen the financial position of the company by commencing to build up a reserve fund and carrying forward a substantial sum to next year. In regard to the loans secured by mortgage and debentures, these loans were secured upon the mortgage debentures of the company, and mortgage on a site in Bath for the purpose of carrying out extensions and so forth, until they issued the necessary capital. The capital spent during the year was made up of £7,300 for the purchase of six motor-omnibuses; paid to the Bath Corporation, £8,400; Newton extension opened in August, £11,300; and the York Villa site and a motor-'bus garage, £2,200. The motor-'bus service had fulfilled the expectations they had formed in regard to it. They had rather more than paid their own way, and had acted as very valuable feeders to the tramway system. They had ordered six more 'buses, which they hoped would be delivered in time for the summer service. They were petrol 'buses of 40 H.P. They would probably require to issue in the course of the year about £40,000, but exactly how it would be distributed between debenture and share capital, he could not tell at the moment. The net revenue was increased by £2,650; the power expenses at Bath decreased by £240, in spite of increased mileage and traffic; operating expenses were only £95 more; repairs and renewals decreased compared with 1904, by £440. They followed the policy of keeping everything up in first-class working order, and as they did that out of revenue, it was not necessary to charge anything special for depreciation. In about 18 months the sinking fund of the debentures would commence, and that fund in itself formed a kind of depreciation fund. Management expenses decreased by £750, due to a large extent to the fact that they had made a new arrangement with Mr. McCarter by which his fixed salary was considerably reduced, and he was permitted to give his attention to other tramway systems as consulting engineer. The London expenses fell by £360. As last year a shareholder complained that he did not give enough statistics in regard to the working of the system, he would now give them:—

	1904.	1905.	Inc. or dec.
Units generated	1,227,200	1,411,900	+184,700
Cost per unit	·636d.	·511d.	—·124d.
Single track miles	16	19	+3
Car-mileage	900,200	967,600	+67,400
Passengers carried	6,648,100	6,746,300	+98,200
Times population carried	85·68	87	+1·32
Cost per car-mile	5·268d.	4·791d.	—·477d.
Receipts per car-mile	8·831d.	8·654d.	—·177d.
Per cent. costs to receipts	59·65 %	55·36 %	—4·29%
Average miles per car per day	89	99	+10
Advertising	£616	£852	+£236
Parcels	£346	£660	+£314

There was some discussion on various points. One of these related to the recent run of an electric omnibus, and in reply to questions, Mr. A. A. CAMPBELL SWINTON, a director, said that electric 'buses had been tried over and over again, and the trouble was the extreme weight of the accumulator. Bath was a very hilly place—as bad a place for electrical vehicles as they could find. In regard to the charging only taking three minutes, that was not the case; it took three minutes to change the batteries, they took hours to charge. There was not the slightest doubt that, so far as Bath was concerned, the petrol 'bus was vastly superior.

The report was adopted.

Cuba Submarine Telegraph Co.

THE meeting of this company was held on Wednesday last week at 58, Old Broad Street, E.C.

Mr. C. W. PARISH, who presided, said, in moving the adoption of the report, that the accounts covered a period of six months to December 31st, 1905, and he thought they showed a satisfactory state of business. Turning to the revenue side they would see that the receipts amounted to £13,151. Interest on investments amounted to £1,490, so that the total receipts had been £14,647. There had been an increase in traffic receipts of £1,205, as compared with the latter half of 1904, but it had to be remembered that during that period the cables were interrupted. Generally speaking, the business in 1905, so far as the period from July to December was concerned, had been better than the same period in 1904. The total receipts showed an increase of £833, while the expenses had been reduced by £2,111, a total improvement of £2,944 upon the year's working. Expenditure during the six months under review amounted to £6,257. During the year 1904, heavy payments were incurred on account of the hire of land cables, it having been the object of the directors to keep up a good service, an object which he felt sure had met with the approval of the shareholders. Their present increase of revenue had enabled the directors to transfer £1,818 to reserve fund, bringing it up to £87,000, and after allowing for the dividends, they would have a balance of £5,603 to carry forward. The capital expenditure had increased from £214,309 to £215,571. For many years there had been no addition to their capital expenditure, but last year they purchased a house at Cienfugos, in the principal business part of the town, and this partly accounted for the increase. The claim of £8,174 against the American Government for the repairing of cables damaged during the Spanish-American war, was still unsettled, and it was proposed in future to leave it out of the accounts, although it would still be pressed. No attempt had been made to meet the claim, although Mr. Root, the Secretary of State, had recommended that the similar claim of the French Government should be met. The law suit against the Cuban Government for the payment of the subsidy on the coast lines was under consideration, but he was sorry to tell them that that morning they had received a cable stating that judgment had been given against the company in the Superior Court. The directors considered that they were clearly entitled to the subsidy, and they would have to appeal to the Supreme Court.

The report was adopted.

Raworth's Traction Patents, Ltd.

THE directors' report for 1905 says that the prospectus was issued in December, 1904, and 10,224 preferred ordinary shares of £1 each were allotted. The total amount received on capital account is £7,667. In terms of the agreement for the sale of the letters patent and goodwill, 15,000 deferred ordinary shares were allotted as fully paid and £3,600 was paid in cash to the vendor for the completion of the purchase. During the year applications for three new patents have been made, and protected by provisional specifications. Under these inventions a controller has been produced which is similar in appearance and in the method of handling to the ordinary series-parallel controller, and gives practically similar results, with the benefits of regeneration, more perfect control and powerful braking effect. The gross profit for the 14 months amounted to £4,428, and the expenditure, including £636 written off preliminary expenses, furniture and experiments and development accounts, to £3,159, leaving a balance of £1,269. It is proposed to pay a dividend at the rate of 6 per cent. per annum on the preferred ordinary shares, £395; 4 per cent. on deferrred ordinary, £600; and to carry forward £273.

During the period under review orders to the value of £21,699 have been received, and £17,729 invoiced. There are now 89 cars in operation with Raworth's regenerative control. Mr. Raworth has accepted the office of managing director, and has appointed the company sole agents for the sale of his foreign and colonial patents. The results of working on a large scale with 40 cars equipped with automatic regenerative control for a period of over 10 months, confirms the experienee of the early experiments, and substantial savings have been shown.

Indo-European Telegraph Co.

MR. J. HERBERT TRITTON presided on Tuesday at the meeting held at 18, Old Broad Street. In moving the adoption of the report, (see ELECTRICAL REVIEW, April 20th) which recommended a dividend for the half-year of 17s. 6d. per share (making, with the interim dividend already paid, 6 per cent. for the year) and a bonus of 20s. per share, both free of income-tax, also that a special distribution of 15s. per share, the chairman said that the year for their company had been, generally speaking, uneventful, with a return to more or less normal traffics. The difficulties to which a long line such as theirs was exposed in traversing districts difficult of access, and liable to temporary disturbance, had perhaps been slightly more in evidence, but those difficulties had, as often before, been overcome by the ready help of the responsible authorities, and the zeal and activity of the staff. The lines of the company had worked most efficiently. The Wheatstone system had now been in use for three years, and the success of this automatic transmission of messages had placed the company in a very strong position. The carrying capacity of the line had been doubled and errors reduced to a minimum. After making allowance for a certain amount of interest on cash investments, which usually appeared in the revenue account, but had this year been otherwise treated, there was a net decrease in traffic receipts of about £8,500. This was due principally to the further reduction of the rate to India from 2s. 6d. to 2s. per word, which came into operation on August 1st, 1905. In spite of the view held by many that the effect of a reduction of rates was generally counterbalanced by a corresponding increase in the number of telegrams sent, this happy result had not yet been reached in the present case. The South Russian traffic showed a most satisfactory increase in volume, but the reduction of the rate to 4½d., which had operated in the accounts for the whole year under review, as against six months for the previous year, had brought the receipts from this traffic for the year down to about the same figure as for the last year. The Indian traffic receipts might still continue to diminish during 1906, though he did not at all take a pessimistic view of the financial position of the company generally; fluctuations in receipts were bound to occur, and they must take the rough with the smooth. The working expenses, £70,792, showed a decrease of £1,138, against 1904, but these again were fluctuating, and certain temporary staff expenses would probably somewhat increase this heading during 1906. The directors had, during the last few weeks, concluded arrangements with the company's concessionary Governments and with the Black Sea Telegraph Co., which had enabled them to reduce the rate between England and Turkey in Europe and Asia, *vid* the company's route and the cable of the Black

Sea Telegraph Co., from 11d., at which it had hitherto stood, to 6½d. per word. The advantage of direct Wheatstone working between London (Liverpool and Manchester) and Constantinople without intermediate retransmission, which had been rendered possible by the co-operation of the Black Sea Co. so far as the section Odessa-Constantinople was concerned, would attract a considerable amount of Turkish traffic, which, under the former relatively prohibitive tariff by their line of 11d, went by other routes. This traffic would be an additional source of revenue. The Russian section of the line passed to the Russian Government on January 31st, 1905, being thereafter leased by that Government to this company for the period of their concession, the maintenance remaining in the company's hands and at their own expense. The transfer of this section from the financial point was dealt with in the accounts for the year under review. The capital cost, which stood in the last balance-sheet at £313,285, had been written off out of the reserve fund, which, after credit of interest, was reduced to £138,629. The reserve fund investments thus displaced had been amalgamated with the "cash investments" of former accounts under the new heading "unappropriated investments," which stood at the value of £100,581. The payment of £5,000 to the trustees of the retirement trust fund went far to complete the required capital amount.

The motion was seconded by Mr. Charles Holland, and carried.

The retiring directors and auditors were re-elected, and a vote of thanks closed the meeting.

Oriental Telephone and Electric Co.

The directors' report for 1905 shows that, including £1,721 brought forward at December 31st, 1904, and after deducting the interim dividends of 3 per cent., paid November 1st, on both the preference and ordinary shares, together with £1,232 interest on debenture stock issued, and providing for a sinking fund for the redemption of the share capital of the company and other charges as shown in the net revenue account, the amount to be dealt with is £16,335. The directors recommend a final dividend for the year of 3 per cent. on the preference shares, £1,425; a final dividend of 4 per cent. on the ordinary shares, making 7 per cent for the year, £7,173; transfer to reserve account, £6,000; and to carry forward £1,738.

For the purpose of meeting the cost of converting subscribers' lines to metallic circuits, of extending and developing its telephone and electric lighting business, as previously intimated, and of assisting the subsidiary companies as far as they may require financial aid for like purposes, the directors were authorised at an extraordinary general meeting of the shareholders, held on May 31st, 1905, to create redeemable debenture stock to the extent of £200,000, and to issue the same from time to time, and on such terms as they saw fit. £100,000 of this stock was issued in June last, carrying interest at £4 per cent., and the stock is now quoted in the Official List. The exchanges worked by the company continue to expand, and this has been particularly noticeable at Rangoon and Singapore. Underground cabling operations are steadily proceeding in Bombay and Singapore, and work is now going on in Calcutta, Rangoon and Madras. The Indian local companies have paid the same dividends as for 1904—viz., the Bengal Telephone Co., Ltd., 5 per cent., and the Bombay Telephone Co., Ltd., 6 per cent., and the amounts have been included in the revenue account.

The Telephone Co. of Egypt has declared dividends of 7½ per cent. for the past year on both its preferred and deferred shares; these also have been included in the accounts. That company continues to receive further contracts from the Government of H.H. the Khedive for the installation of additional provincial telephone lines. In order to provide that company with funds for this and other extensions, the directors, on behalf of the company, have taken up a further 4,000 preferred shares of £5 each.

The China and Japan Telephone and Electric Co.'s exchange at Hong Kong has made considerable progress during the year. The underground and overhead cabling referred to in last year's report is now almost completed, towards the cost of which the directors have increased the company's debenture holding in that company by £7,000. The total cost exceeds £12,000, but the company itself has been able to provide the rest. The directors have established a sinking fund for the redemption of the share capital of the company calculated over a period of 50 years.

Monte Video Telephone Co. — The directors have resolved to pay an interim dividend for the six months ended January 31st, 1906, at the rate of 4 per cent. per annum on the ordinary shares, and at the rate of 5 per cent. per annum on the preference shares. The dividend will be paid on 1st prox.

Calcutta Electric Supply Corporation.—The number of units delivered to consumers during the four weeks ended February 23rd, 1906, were 244,055, compared with 187,706 units in the corresponding four weeks of the preceding year, and during the five weeks ended March 30th, 1906, 370,234 units, as compared with 319,352 in the preceding year.

London Electric Supply Corporation.—In a circular just issued to the shareholders and debenture stockholders, it is announced that one of the most important electrical power supply contracts yet made in London has been entered into by the Corporation for the supply of power to the London, Brighton and South Coast Railway for working the trains on their South London line between London Bridge and Victoria. The contract is for a period of seven years. This is the large contract referred to at the annual meeting, and is in addition to the new contract entered into with the London County Council for a period of three years for the supply of power to the Council's tramways to commence at the expiration of the existing agreement.

Montreal Light, Heat and Power Co.—Dividend for the three months ending April 30th at the rate of 4 per cent. per annum.

Prospectus.—*Simplex Conduits, Ltd.*—This company is formed to acquire the Simplex Steel Conduit Co., Ltd, which needs no introduction to anybody in any way interested in electrical affairs. The registration of the new company and its capital and objects have already appeared in the Electrical Review for April 13th in our "New Companies Registered" section, and a copy of the prospectus appears in our advertisement pages this week. The present issue, it will be observed, is of £40,000 in 6 per cent. cumulative preference shares of £5 each, and £40,000 in £1 ordinary. The latter are to be issued to the vendor company in part payment of the purchase money, and the former are issued to the public. There is also £36,494 purchase money payable in cash, and bearing 5 per cent. per annum interest from December last. Mr. L. M. Waterhouse, who has been so prominently associated with the old company, will be managing director of the new at a salary of £1,000 and a commission of 2½ per cent. on the net profits. The figures set out in the prospectus show that the average profits during the past six years have been £12,232 before deducting depreciation, directors' fees and removal expenses. There was a drop in profits during 1905, but bad trade and partial dislocation of trade during removal of the works from Digbeth to Garrison Lane are held responsible. It is stated that, so far this year, there is a satisfactory increase over the net sales of the corresponding period of 1905, at slightly higher prices. The new works were erected to cope with the development of the business, and it is anticipated that the cost of manufacturing will be considerably reduced by the aid of the up-to-date equipment.

Toronto Electric Light Co.—The directors' report for 1905 states that the income was $775,948, and the expenses (including interest on debentures) $471,318. Out of the balance ($304,629) four quarterly dividends (7 per cent. per annum) have been paid, and $95,693 is carried forward. The *Times* quotes:—"The alterations and extensions to the company's plant, which have been going on for the past few years, have made satisfactory progress since the last annual meeting. A new sub-station on Teraulay Street for the reception and distribution of Niagara power is nearing completion, and a considerable part of the necessary machinery has been installed. Satisfactory progress has also been made in extending the underground system of distribution."

F. Reddaway & Co.—After placing £15,000 to reserve, a dividend of 3 per cent. on the 6 per cent. non-cumulative preference shares for 1905 is recommended, and £2,829 is carried forward.

Worcester Electric Traction Co.—The fourth ordinary general meeting of this company was held on Thursday last week at the offices, Donington House, Norfolk Street, W.C. Mr. H. S. Day (chairman) presided, and the business was purely formal.

Meldrum Bros.—The report for 1905 states that after making full allowance for depreciation, provision for bad and doubtful debts, paying managing directors' salaries, and writing off large amounts expended in developing the business, there remains a debit balance of £9,808 on the year's working. This is stated to be principally due to a large number of contracts standing over longer than was anticipated. The directors anticipate a profit for the current year large enough to wipe out the above balance and to leave a substantial profit. The directors have voluntarily relinquished the dividend paid them on their vendors' shares for the half-year ended December 31st, 1904. Such dividend, amounting to £2,000, has been repaid by them to the company.

Babcock & Wilcox.—At the annual meeting on 19th inst., Mr. J. Dewrance, who presided, congratulated shareholders upon the satisfactory report. The result could only be obtained by a business of huge magnitude. They had an excellent organisation, capable of dealing with anything that cropped up. How long such a result could be produced even with the best possible organisation he could not say, but the present year promised to be as good as last. In reply to a shareholder who asked whether the company was going to embark on the manufacture of suction gas plant, the chairman said that the directors felt that a great amount of consideration would be necessary before going in for the manufacture of gas plant. A large number of people were going in for suction gas plant, but whether a profit was to be made out of it was another question. The report was adopted.

Tynemouth and District Electric Traction Co.—Mr. W. J. Greer, presiding at the annual meeting on 20th inst., said that there was a decrease of £1,412 (3 per cent. on the ordinary capital) due to the bad trade and competition of the North-Eastern Railway, who were running a much more frequent service. There was a reduction of £64 in power and running expenses, but repairs and maintenance were £157 more than in 1904. They proposed to pay altogether 3½ per cent. for the year on the ordinary shares, to place only £600 to depreciation, and carry forward £137. They hoped for better traffic results this year. The receipts so far were slightly better than last year. The report was adopted. An alteration in the articles was agreed to at a subsequent meeting.

City of Birmingham Tramways Co.—The directors' report for 1905 shows that after paying interest on debentures and dividend on preference shares, there remains a surplus of £72,722. A dividend at the rate of 10 per cent. for the year is proposed, £64,304 being placed to the reserve fund (increasing it to £361,055).

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	*
Aberdeen	Apr. 21	2,653	+ 331	47	62,875	— 305	14·4	..
Ayr	,, 14	477	+ 31	47	13,309	— 79	8	..
Bath	,, 21	2,017	+ 837	16	10,933	+ 2,058	13	..
Belfast	,, 20	7,459	+3,114	16	48,344	+12,642	40	+ 6½
Birkenhead	,, 22	2,357	+ 368	3	3,436	+ 220	13·5	..
Blackburn	,, 18	2,802	+1,088	3½	4,052	+ 1,140	13·75	..
Blackpool Corp.	,, 19	2,825	+1,942	3	3,189	+ 1,936	11·87	..
,, —Fleetw'd	,, 21	1,554	+ 796	16	4,320	+ 773	8·25	..
,, —Lytham	,, 19	1,281	+ 927	24	4,697	+ 1,197	7½	..
Bolton	,, 22	4,960	+ 780	3	7,136	+ 430	26	+ 1
Bournemouth	,, 18	4,056	+2,071	2½	4,764	+ 2,100	17·4	+ 7½
Bradford	,, 21	10,409	+2,479	3	14,664	+ 2,801	53	..
Brighton	,, 22	2,172	+ 300	3	3,115	..	9·5	..
Bristol	,, 20	11,897	+2,582	..	..	..	28·5	..
Brit. Elec. Trac. Co								
Airdrie	Apr. 13	454	+ 63	15	3,209	+ 343	3·65	..
Barrow	,, 13	532	+ 102	,,	3,117	+ 300	5·37	..
‡Birmingham (City)	,, 13	10,823	— 645	,,	76,679	— 3,555	14·5	..
Birmingham (Mid.)	,, 13	2,933	— 753	,,	20,313	— 5,342	12·25	..
Devonport	,, 13	1,046	+ 67	,,	6,149	— 278	8·85	..
Dudley—Sto'rb'ge	,, 13	1,609	+ 37	,,	11,121	+ 260	21·25	..
Gateshead	,, 13	1,970	+ 189	,,	13,587	+ 748	11·25	..
Gravesend, N'fleet	,, 13	472	+ 90	,,	2,959	+ 135	6·5	..
Greenock	,, 13	1,461	+ 174	,,	8,704	+ 708	7·25	..
Hartlepool	,, 13	587	+ 118	,,	3,787	+ 230	6·72	..
Leamington	,, 13	344	+ 246	,,	1,997	+ 837	3	..
Merthyr	,, 13	414	+ 24	,,	2,643	— 1	2·9	..
‡Metropolitan	,, 13	7,645	+3,454	,,	42,822	+14,017	22	..
Middleton	,, 13	725	+ 124	,,	4,293	+ 322	8·5	..
Oldham — Ashton	,, 13	1,189	+ 148	,,	7,659	+ 874	9·13	..
Peterborough	,, 13	258	+ 34	,,	1,485	— 64	5·31	..
Potteries	,, 13	3,616	+ 274	,,	25,701	+ 1,480	29	..
Rothesay	,, 13	282	+ 143	,,	910	+ 188	2·75	..
Southport	,, 13	602	+ 89	,,	3,543	+ 63	8·17	..
South Staffs.	,, 13	1,655	+ 298	,,	11,403	+ 1,783	13·87	..
Swansea	,, 13	1,695	+ 732	,,	10,770	+ 3,879	5·5	..
Tynemouth	,, 13	481	+ 107	,,	2,520	— 45	3·75	..
Weston-s-Mare	,, 11	103	..	,,	450	— 13	3	..
Wolverhampton D.	,, 13	776	+ 68	,,	5,531	+ 456	14·75	..
‡Worcester	,, 13	534	— 29	,,	3,487	— 331	5·75	..
Yorks. Wool. Dist.	,, 13	1,756	+ 554	,,	12,073	+ 3,848	17	..
Miscellaneous	,, 13	4,063	+ 112	,,	26,449	+ 38	..	..
Burnley	Apr. 21	2,686	+ 281	..	..	..	7·5	..
Burton-on-Trent	,, 22	655	+ 28	3	957	+ 1	8·5	..
†Bury	Mar. 25	815	..	51	39,120	..	10·5	..
†Cardiff	Apr. 7	1,953	+ 55	1	1,953	— 370	15·87	..
Carlisle	,, 21	403	+ 32	16	2,600	+ 187	..	..
Chatham and Dist.	,, 19	1,546	+ 297	16	9,418	+ 80	9·33	+ 8
Colchester	Mar. 7	327	— 5	31	5,660	..	7½	+ ½
†Cork	Apr. 19	509	+ 60	16	6,658	+ 83	9·89	..
Darlington	,, 21	441	+ 64	3	651	+ 71	4·87	..
Darwen	,, 20	607	+ 109	3	781	+ 55	4·36	..
Dover	,, 21	565	+ 162	3	769	+ 152	4·75	+ 1½
Dublin	,, 20	10,436	+1,222	16	72,616	+ 2,479	48·5	+ ·5
Dundee	,, 18	2,204	+ 575	48	45,563	+ 4,745	12·5	..
East Ham	,, 21	2,188	+ 640	3	3,072	+ 773	8	+ ½
Exeter	,, 20	677	+ 192	3	883	+ 215	4·25	..
Glasgow	,, 21	33,521	+3,740	46	720,157	+49,594	79·5	+ 6
†Gloucester	Feb. 21	221	+ 12	..	..	..	15	..
Halifax	Apr. 11	2,283	— 31	2	2,339	— 29	37	+1·5
Hastings	,, 20	1,855	..	..	..	..	..	..
†Huddersfield	,, 21	1,953	+ 693	3	4,872	+ 1,130	28	..
Hull	,, 21	4,756	+ 553	3	6,923	+ 80	13	..
†Ilford	,, 21	686	+ 190	3	1,668	+ 312	6·37	..
Ilkeston	,, 18	269	+ 52	3	379	+ 45	3·5	..
Ipswich	,, 21	969	+ 143	3	1,342	+ 178	10·5	..
Isle of Thanet	,, 21	1,153	+ 311	16	4,499	+ 139	11	..
Kilmarnock	,, 21	320	+ 18	49	7,394	..	4·12	..
Kirkcaldy	,, 18	422	+ 19	..	..	..	7·5	..
Lan'kshire Trm. Co.	,, 19	1,787	+ 511	16	13,178	+ 3,099	12·5	+ 3·9
Leeds	,, 14	12,091	+1,167	2	12,091	+ 1,254	89·5	+ 8
Leicester	,, 21	4,957	+ 983	16	32,984	+ 4,166	..	..
Leith	,, 14	958	+ 548	47	17,946	..	6	+ 1
Liverpool	,, 14	21,580	+ 728	15	154,099	+ 5,061	104	+ 1
†L.C.C.	,, 7	15,424	+2,019	1	..	..	51	+ 5·6
London United	,, 20	16,499	+6,039	16	83,337	+ 7,379	41	..
†Lowestoft	,, 21	164	+ 16	30	3,881	— 86	3·5	..
Manchester	,, 21	27,846	+3,060	3	40,817	+ 4,467	84	..
Nelson	..	..	..	..	..	..	..	..
Newcastle	,, 21	8,650	+1,200	3	12,450	+ 1,323	25·5	..
Newport	,, 14	1,257	+ 149	2	1,257	+ 149	14·5	+ 1·5
Northampton	,, 20	998	+ 235	3	1,279	+ 246	5·5	..
Oldham	,, 22	3,846	+ 684	4	7,274	+ 557	23·75	+ 1·6
Pontypridd	,, 21	438	+ 11	3	616	+ 79	3·5	..
Portsmouth	,, 21	4,561	+1,146	3	6,237	+ 889	14·5	..
†Preston	,, 18	912	+ 378	..	..	..	10	..
†Reading	,, 19	771	+ 170	3	1,757	+ 149	7·5	..
Rochdale	,, 21	2,489	+1,345	3	3,485	+ 1,653	21·2	+ 5·8
†Rotherham	,, 19	688	+ 301	3	1,447	+ 288	9·3	..
Salford	,, 16	9,738	+1,887	2	10,801	+ 1,025	38·9	..
Sheffield	,, 22	10,919	+1,747	4	20,895	+ 1,977	35·75	+ 1·5
Southampton	,, 11	..	..	1½	1,368	+ 54	..	..
Southend-on-Sea	,, 18	837	+ 312	3	973	+ 251	6	..
Stalyb'dge, Hyde, &c.	Mar. 31	1,184	+ 126	52	32,745	..	21	..
†Stockport	Apr. 13	1,079	+ 612	2	1,725	+ 875	15·5	+ 4
†Sunderland	,, 7	1,392	— 88	1	1,392	— 88	10·87	..
†Swindon	,, 11	181	+ 12	1½	379	..	4·4	..
Tyneside	,, 18	1,340	+ 663	16	6,079	+ 766	8·87	..
Warrington	Mar. 29	677	+ 43	52	17,804	+ 1,247	6·37	+ ·25
West Ham	Apr. 19	5,204	+2,933	3	7,338	+3,880	9·78	+ 4·9
Wolverhampton	,, 19	1,855	..	..	..	..	10	..
Yorks. W. Riding	,, 22	2,126	+ 796	16	11,767	..	..	..
Baker St.-Waterloo	,, 21	2,744	..	6	9,071	..	3·25	..
Cen. London Rly.	,, 21	12,049	— 928	16	109,330	— 4,012	6	..
City & S. Lon. Rly.	,, 22	5,041	— 243	16	46,659	+ 194	6·25	..
Dublin-Lucan Rly.	,, 20	298	+ 60	16	1,545	— 80	7	..
G. N. and City Rly.	,, 21	3,400	+ 136	16	28,903	+ 1,073	3·5	..
L'pool Overh'd Rly.	,, 22	2,953	— 55	16	22,334	— 1,325	6·65	..
Mersey Railway	,, 21	3,549	+ 333	16	27,427	+ 1,646	4·5	..
Metropolitan Rly.	,, 22	31,673	—3,385	16	265,665	— 7,927	70·5	..
Met. District Rly.	,, 22	14,213	+ 467	16	127,369	+ 6,793	24	..
Anglo-Argentine	,, 22	30,728	+3,208	16	239,689	+24,862	43	..
§Auckland	Mar. 30	9,584	+ 482	13	31,292	+ 1,310	18·64	..
§Brisbane	,,	11,511	+1,569	..	..	..	..	..
†Bu'n's A'r's E.T. Co.	,, 17	1,333	+ 128	11	15,558	+ 3,562	24	..
Bu'n's A'r's-Blgr'no	Apr. 15	7,272	+ 225	15	53,225	+ 4,311	..	..
Calcutta	,, 21	5,559	+ 576	..	..	..	..	..
§Cape Electric T. Ld.	Mar.	16,188	..	..	..	..	..	..
§Geneva	,,	6,485	..	..	..	..	..	..
Perth (W.A.)	Apr. 20	3,050	+ 156	16	24,492	+ 1,308	24·25	+ ½

* Compared with the corresponding period of 1905. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Wednesday Evening.

For writing upon Stock Exchange subjects this week, the blackest ink and the most sombre mood are alone appropriate. We do not mean to say that any panic is either present or approaching, but depression, due to events political, financial and material, stalks in most of the Stock Exchange paths. It will want an exceptionally good Budget to counteract the uncomfortable tightening of the Money Market.

Telegraph stocks, however, resist the otherwise prevalent gloom with a reasonable degree of success. Anglo-American stocks are quite strong. It's an ill earthquake that profits nobody, and the company's lines to New York are doing good business now. Direct United States shares remain at 15½, and Commercial Cable Certificates are even a point lower, these last sympathising with the flatness in American Railroad shares. Indo-Europeans are again better at 59½, and some of the prior-charge stocks in the Eastern group have advanced, though "China" shares are a shade lower at 14⅜. Globe Preference moved up ⅛ to 14⅞, and two improvements occurred in the West India and Panama quartette. The Ordinary at 1⅛ are ⅛ up, and the Second Preference show ⅛ gain at 7, upon what grounds it it difficult to say, for what should be the best authority tells that the company's increased receipts are due mainly to the misfortunes of neighbours, and not to trade which is likely to prove permanent.

National Telephone Deferred is ½ easier at 110½, and the Preferred continues somewhat lumpish. Expectation puts the repayment price of the Preferred at 105 at least, so that allowing for extinction of the stock, the yield upon the money at 109 works out to rather more than 4¾ per cent.

That egregious proposition, the Electrobus Company, has obtained the reception from the critics which it richly deserved. Those who read the foreword about the concern in last week's Electrical Review were prepared for this sort of welcome. Some of the allotments, to our knowledge, were out on Wednesday morning, although the lists were not advertised to close until "on or before Thursday."

None of the Ordinary shares in the list of Metropolitan electric lighting companies have varied in price for the last fortnight. This is less a tribute to the steadiness of the market than a sign that nobody cares to deal. Newcastle-on-Tyne Ordinary are down ½ to 7½, which is a poor compliment to the Exhibition. The Newcastle and District shares are 11⅜ and 9 for the shares, £9 paid and £6 paid respectively. Hove Ordinary lost ¼. County of Durham Electrical Power Ordinary are now £3 paid, and stand at that price. Havana Electricity rose 15s. to 9 middle. South Wales were inquired for the other day, and a seller at Cardiff who was bid 4, demanded 5 and then withdrew his offer, so that there is still a small buyer in the market. Perhaps the Cleveland will be the first of these companies to show how rapid success can reward the efforts of people grown practical in the [school of] expensive experience elsewhere.

Home Railway stocks are dull with a dullness that may be called dismal. Metropolitans dropped to 72 on Tuesday, though the price rallied afterwards.

A week ago it stood at 77½, and Districts were 28½. The latter have since been offered at 26, and some question of depreciation has been started which upset the market in both these underground stocks. Metropolitan traffics, too, are poor. Waterloo and City Ordinary receded a point, and so did Central London Deferred on the decrease in the traffics. Great Northern and City Preferred gave way ¼, and are no better than 4¼ for the £10 shares fully-paid.

Other traction varieties have little to distinguish their movements. London Motor-Omnibus dropped to 25s. upon the advent of the Electrobus prospectus, but the price soon recovered to 1⅞. Electrically-propelled 'buses, run at a good profit, there may yet be, but they are not likely to run under the ægis of the present Electrobus Company. Anglo-Argentine Trams are ⅜ lower, and there is some disappointment felt at the refusal of the board to issue any sort of fractions of new shares. Calcutta Trams, old and new, are both 5s. lower.

Amongst manufacturing shares, British Aluminium have hardened again, and at 2⅞ are ⅜ to the good. Castner-Kellner put on ⅛, and Babcock Preference at 1⅝ have also advanced this amount. On the other hand, Henley's Preference drooped a trifle.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations April 18th.	Closing Quotations April 25th.	Business done week ended April 25th, 1906. Highest	Lowest.	Rise + or Fall —
17,700	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	4 %	98½ -101½	99 —102	..	..	+ ½
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3¾— 4¼	3¾— 4¼	..	..	..
155,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	88 — 88	88 — 88	..	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	2⅜%	3½%	64 — 66 xd	66 — 68 xd	..	..	..
8,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5⅝%	6 %	111½—112½xd	113½—114½ xd	114	112	..
2,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	½%	20¼— 21¼	22 — 22½	22¾	20⅝	+ 1¼
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	101 —103	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	8 — 8¼	8 — 8¼	..	..	..
1,932,856	Commercial Cable Stng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	97 — 99	96 — 98	97⅜	96⅜	—1
16,000	Cuba Telegraph	10	6½%	10 %	5 %	5 %	8½— 9	8⅝— 9⅛	9⅛	9	+ ⅛
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17 — 18	..	..	..
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜— 3⅝	3⅜— 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8½— 9	8⅝— 9	..	..	..
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —103 %	100 —103%	101¼	..	..
60,710	Direct United States Cable	20	3½%	3 %	3½%	3½%	15½— 15⅝	15½— 15⅝	15⅛	15⅞	..
70,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	101 —103	..	..	+1
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	144 —147 xd	144 —147 xd	146¾	144⅝	..
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	89 — 91 xd	89 — 91 xd	90⅜	89½	..
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	107 —109	107½—109½	108¾	..	+ ½
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	14⅜— 15⅛	14⅜— 15⅝	14¾	14⅜	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105 —107	105½—107½	..	..	+ ½
300,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 —103 %	101 —103 %	101½	..	..
180,887	Globe Telegraph and Trust	10	£3	5⅝%	5⅝%	5 %	10⅞— 11⅛	10⅞— 11⅛	11⅛	10⅝	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅜— 14⅝	14⅜— 15	14⅝	14⅜	+ ⅛
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	40 — 42	40 — 42	40⅝	..	..
42,300	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 —102	101 —103	..	..	+1
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	13 %	£8 — 60	58½— 60½	59⅛	56½	+ ½
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1⅛— 1⅜	1⅛— 1⅜	24/4½	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	8 %	8 %	4 %	..	1⅛— 1 1/16	1⅛— 1 1/16	..	..	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	⅞— 1	⅞— 1	..	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	108 —110	108 —110	109⅛	108	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	110 —112	109½ -111½	110⅜	110	— ½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	12 — 14	12 — 14	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10½— 12½	10½— 12½	11¼	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5¼— 5½	5¼— 5½	..	..	..
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	99 —101	98½ -100½	99⅛	98⅛	—½
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	103 —105	103 —105	104⅛	103	..
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6½%	6½%	7½%	1⅜— 1½	1⅜— 1½	28/9	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1¼— 1⅜	1¼— 1⅜	26/3	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	98 —100	98 —100	100	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..
11,839	Reuter's	8	5 %	5 %	5 %	5 %§	7¼— 7⅝	7¼— 7⅝	7⅝	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	103 —106	103 —106	..	..	..
8,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	126 —129 xd	126 —129	..	..	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	..	7 — 7⅞	7 — 7⅞	..	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5¼— 5⅝	5¼— 5⅝	5⅛	5⅛	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 —112	110 —112	110⅜	110⅛	..
15,609	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9⅞— 10⅛	9⅞— 10⅛	10⅛	..	..
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	..	⅝— ¾	⅝— ¾	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	100½	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	5 %	14 — 14½	14 — 14½	14⅜	14⅛	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	101 —103	101 —103	..	..	..
663,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —103	100 —103	103	102⅓	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅛— ¼	⅛— ⅜	15/-	11/6	+ ⅛
84,563	Do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	6 %	8¼— 8½	8¼— 8½	8⅜	..	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	6 — 7	6⅞ — 7⅛	..	..	+ ⅛
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —104	101 —104	103	102¼	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams, 260,008 to 430,007	5	..	..	8 %	8 %	8⅝— 8¾ xd	8½— 8⅝ xd	8⅛	8 1/16	..
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅝— 6⅛	5⅝— 6⅛	6 3/16	6	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	141 —144	140 —143	..	..	—1
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	104 —106	104 —106	..	..	..
800,000	Babcock & Wilcox, 1 to 580,000	1	..	17 %	20 %	20 %	3¾— 4⅛	3¾— 4⅛	81/3	80/7½	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1 3/16— 1 1/8	1⅛— 1⅛	..	..	+ 1/16
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	2⅛— 2⅜	2 1/16— 2 1/16	49/4½	..	+ 1/16
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	7 %	7 %	6 — 6⅛	6 — 6⅛	6 1/16	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5¼— 5⅜	5¼— 5⅜	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	3⅞— 4¼	3⅞— 4¼	82/6	81/3	..
300,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	102 —106	102 —106	103⅜	102½	..
300,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	120 —123	120 —123	..	..	..
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	110 —113	110 —113	111	110½	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	107 —110	107 —110	107⅞	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	101 —103 xd	101 —103	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	102 —105	102 —105	..	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	..	6 — 7	6 — 7	6⅞	6¼	..
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %§	9 — 9½	8⅞— 9⅜	9¼	9⅛	— ⅛
1,115,122	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	111 —114	111 —114	113	112¼	..
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	96½— 98½	96⅜— 98½	..	..	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6½— 7	6⅝— 7	6 11/16	6½	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5¾— 6¼	5¾— 6¼	5⅞	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1⅞— 2⅜	1⅞— 2⅜	41/4½	..	..
1,916,353	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	80 — 85	80 — 85	81	..	..
20,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	1 3/16— 1 5/16	1 3/16— 1 5/16	..	..	..
30,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	¾— 1 xd	¾— 1 xd	15/-	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1¾— 2 xd	1¾— 2 xd	33/9	33/6	..
125,000	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	97 — 99	97 — 99	98⅛	..	..
125,000	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	84 — 86	84 — 86	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3⅜— 3⅝ xd	3⅜— 3⅝xd	68/-	..	..
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5⅝— 5¾ xd	5⅝— 5¾xd	..	..	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	5 — 5⅛ xd	5 — 5⅛xd	5⅛	5⅛	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	106 —108	106 —108	..	..	..
100,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —105	102 —105	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	9⅛— 9⅜ xd	8⅞— 9⅛xd	9⅜	9 1/16	..
32,610	Do. 105,001 to 137,610	5	..	..	..	8 %	8⅝— 9⅛	8¾— 9	8¾	8⅞	— ⅛
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	106 —108	106 —108	..	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	10%	10½— 11¼	10¾— 11⅛	11 1/16	11	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅞— 6	5⅞— 6	..	..	..
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108½—110½	108½—110½	109	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %§	⅞— ⅞	⅞— ⅞	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	..	1 — 1⅛	1 1/16— 1 1/16	23/1½	..	+ 1/16
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	95 —100	95 —100	..	..	..
1,989,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	90 — 92	90 — 92	91⅞	90⅜	..
530,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	100 —102	100 —102	101⅛	100⅜	..
530,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	82 — 85	81 — 84	82⅜	81	—1
1,480,000	City and South London Railway	Stock	3½%	2⅜%	2½%	1⅞%	41 — 43	41 — 43	43	42⅛	..
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	2½%	2½%	..	2 — 2¼	2 — 2¼	42/6	41/3	..
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98 %	95 — 98	..	..	..

* Period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends. ‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued).*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations April 18th.	Closing Quotations April 25th.	Business done week ended April 25th, 1906. Highest	Lowest.	Rise + or Fall—
260,000	Dick, Kerr & Co., 1 to 260,000	† £1	..	..	10 %	..	1⅜ — 1⅞	1⅜ — 1⅞	..	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	£1	..	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	— ⅛
294,150	Do. do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	104 —106	104 —107	..	..	+ ½
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5⅓ %	6 %	6 %	13⅜ — 14⅜	13⅜ — 14⅜	..	..	..
59,987	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14⅛ — 15⅛	14⅛ — 15⅛	..	..	..
63,400	Do. 4 % Debs.	100	..	4 %	4 %	4 %	99½ —100½	99½ —100½	..	..	..
800,000	Do. 3½ % "A" Debs.	100	..	3½ %	3½ %	3½ %	98 — 98⅝	97⅝ — 98	..	..	— ⅛
800,000	Do. 3½ % "B" Deb. Stock	100	..	3½ %	3½ %	3½ %	97 — 97½	96⅞ — 97⅛	..	..	— ¼
99,261	Edison & Swan Utd., "A" shrs., £3 pd., 1 to 99,261	£ Nil	Nil	2⅝ 6	..	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..
17,139	Do. "A" shares, 01—017,139	£ Nil	Nil	2⅝ 6	..	..	2½ — 3	2½ — 3	..	..	..
344,023	Do. 4 % Deb. Stock Red.	100 4 %	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..
100,000	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100 5 %	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	£	6 %	4 %	Nil	..	1/16 — 1/32	1/16 — 1/32	..	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	£ 7 %	7 %	7 %	7 %	..	2 — 2⅛	2 — 2⅛	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Sk.	Stock 4 %	4 %	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	£ 5 %	5 %	5 %	5 %	..	9⅜ — 9⅝	9⅜ — 9⅝	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock 4 %	4 %	4 %	4 %	4 %	94 — 98	94 — 98	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	4⅛ — 4⅜	4 — 4⅛	84/4½	82/6	— ¼
96,000	Greenwood & Batley 7 % Cum. Pref.	£ 10	..	7 %	7 %	7 %	10⅜ — 11¼	10⅜ — 11¼	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	102 — 104	102 — 104	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	£ 5	20 %	15 %	15 %	15%	12⅛ — 13⅛	12⅛ — 13⅛	12⅞	..	..
200,000	Do. do. 4½ % Pref.	£ 5	4½%	4½%	4½%	4½%	5⅜ — 5⅝	5⅜ — 5⅝	..	..	— ⅛
41,978	Do. do. 4½ Mort. Deb. Stock	Stock 4½%	4½%	4½%	4½%	4½%	10⅜ —11⅛	10⅜ —11⅛	..	..	..
108,022	Do. do. Scrip. £0 % paid	..	..	..	..	..	57⅛ — 59⅛	57⅛ — 59⅛	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	£ 10	10 %	10%	5 %	10%	17⅛ — 18⅛	17⅛ — 18⅛	17⅞	17½	..
37,500	†Liverpool Overhead Railway, Ord.	£ 10	1⅛%	1⅛%	1¼%	Nil	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..
10,000	† Do. do. Pref. £10 paid	£ 10	5 %	5 %	5 %	5 %	6½ — 7	6½ — 7	..	..	..
600,070	London United Trams (1901), 1 to 50,007	£ 10	..	8 %	6 %	3 %	7⅛ — 8½	6 — 8	..	..	—1
399,930	Do. do. 60,008 to 100,000 (£4 paid)	£ 10	..	8 %	6 %	3 %	2 — 3	1 — 2	..	..	—1
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	£ 10	..	5 %	5 %	5 %	9½ — 10	9½ — 10	9⅝	..	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	95 — 98	96 — 90	98	97½	+1
314,016	Metropolitan Electric Trams, Defd.	£ 1	Nil	Nil	Nil	3 %	5/32 — 7/32	1/32 — 1/32	3/3	2/6	..
500,000	Do. 5 % Cum. Pref.	£ 1	5 %	5 %	5 %	5 %	7/8 — 1	7/8 — 1	19/3	17/9	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½ %	4½ %	103 —105	102 —104	102½	..	—1
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	£ 5	..	..	6 %	6 %	5½ — 5⅝ xd	5½ — 5⅝	..	..	..
24,500	Potteries E. Trc., 20,001 to 40 000 & 50,001 to 54,500	£ 10	..	5 %	5 %	4 %	8 — 9 xd	8 — 9	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	£ 10	..	5 %	5 %	5 %	9 — 9½	9 — 9½	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 — 106	..	..	..
87,950	Telegraph Construction and Maintenance	£ 12	20 %	20 %	15 %	15 %	33 — 35	33 — 35	33⅝	33	..
150,000	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100 4 %	4 %	4 %	4 %	4 %	100 —103	101 — 103	..	..	+ ½
8,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	98 —100	97 — 99	97⅝	..	—1
540,000	Waterloo & City Railway, Ord. Stock	100 3½%	3½%	3½%	3½%	3½%	101 —104	100 — 103	102	..	—1
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	£ 5	6⅔%	3 %	Nil	Nil	1⅜ — 2¼	1⅜ — 2¼	..	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	£ 5	..	6 %	Nil	Nil	3½ — 4	3½ — 4	..	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	80 — 85	80 — 85	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	£ 5	..	5 %	5⅓%	4 %§	5⅛ — 5⅜ xd	5⅛ — 5⅜	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	£ 5	8 %	10 %	10 %	10 %	8½ — 9½	8½ — 9½	..	..	..
10,623	Do. do. 7 % Cum. Pref.	£ 5	7 %	7 %	7 %	7 %	8½ — 9½	8½ — 9½	..	..	..
300,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	103 —106	102 —105	..	..	—1
80,000	Charing Cross and Strand Electricity Supply	£ 5	10 %	8 %	8 %	5 %	4 — 5	4 — 5	90/0	..	..
80,000	Do. do. do. 4½ % Cum. Pref.	£ 5	4½%	4½%	4½%	4½%	4⅜ — 4⅞	4⅜ — 4⅞	..	..	..
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	£ 5	4½%	4½%	4½%	4½%	4 — 4⅓	4 — 4⅓	..	..	..
40,000	Do. do. 1903	£ 5	..	4½%	4½%	4½%	4 — 4⅓	4 — 4⅓	..	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —103	101 —103	101⅜	..	..
44,436	Chelsea Electricity Supply, Ord.	£ 5	4½%	5⅓%	6 %	6 %	5¼ — 5⅜	5¼ — 5⅜	5⅜	..	..
175,000	Do. do. 4½ % Deb. Stock Red.	Stock 4½%	4½%	4½%	4½%	4½%	107 —109	107 —109	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	£ 10	5 %	5 %	6 %	6 %	10½ — 11	10⅜ — 11	10⅝	10⅜	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	£ 10	6 %	6 %	6 %	6 %	13 — 14	13 — 14	13⅞	13	..
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	..	..	..
300,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	101⅛	..	..
40,000	County of Durham Electrical Power, Ord.	£ 2	4 %	4 %	£3 7 0	4 %	1⅞ — 2⅛	2⅛ — 3⅛	62/6	..	+1
50,000	Do. do. do. 5 % Pref.	£ 5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	£ 10	4 %	4 %	4½%	5 %	8 — 9	8 — 9	..	..	..
30,000	Do. do. 6 % Pref., 40,001—60,000	£ 10	6 %	6 %	6 %	6 %	11¼ — 12¼	11¼ — 12¼	12⅛	..	..
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	109 —112	109 —112	..	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —103	101 —103	102⅛	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	£ 5	7 %	7 %	7 %	5 %§	3⅜ — 4¼	3⅜ — 4¼	..	..	..
80,000	Do. do. 6 % Cum. Pref.	£ 5	6 %	6 %	6 %	6 %	5 — 5⅓	5 — 5⅓	..	..	..
820,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	103 —106	103 —106	102½	..	..
10,000	Folkestone, 1 to 10,000	£ 5	..	5½%	5½%	5½%	5¼ — 5⅝ xd	5¼ — 5⅝	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	£ 5	..	..	..	5 %	5 — 5⅜	5 — 5⅜	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
13,000	Hove, 1 to 13,000	£ 5	..	8½%	8½%	9 %	8¼ — 9	8¼ — 8⅝	8⅝	..	—⅛
10,000	Do. New (£5 10s. paid)	£3	..	8½%	8½%	9 %	8½ — 9	8¼ — 8⅝	..	..	—⅛
37,300	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	98 —101	98 —101	..	..	..
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	98 —101	98 —101	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	£ 5	10 %	12½	12 %	10 %	9½ — 10½	9½ — 10½	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock 4 %	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	£ 3	Nil	Nil	3 %	4 %	2 — 2½	2 — 2⅛	17/6	45/-	..
60,000	Do. do. do. 6 % Pref.	£ 5	6 %	6 %	6 %	6 %	5 — 5⅜	5 — 5⅜	5⅜	5⅛	..
874,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock 4 %	4 %	4 %	4 %	4 %	98 —101	98 —101	100	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	£ 5	7½%	8½%	10 %	10 %	8½ — 9½	8½ — 9½	8⅝	8⅛	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	£ 5	4½%	4½%	4½%	4½%	5⅜ — 5⅝	5½ — 5⅝	5⅝	5⅜	— ⅛
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	110 —114	110 —114	..	..	..
250,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock 3½%	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100 4½%	4½%	4½%	4½%	4½%	101 —103	101 —103	102	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	£ 5	..	8 %	8 %	8 %	7⅞ — 8⅛	7¼ — 7⅝	..	..	— ⅛
75,000	Do. 5 % Pref., 1 to 75,000	£ 5	..	5%	5 %	5 %	6 — 6½	6 — 6½	..	..	..
10,852	Notting Hill Electric Lighting	£ 10	6 %	6 %	7 %	7½ %	13 — 14	13 — 14	..	..	..
64,000	Do. do. 4 % 1st Mort Deb.	100 4 %	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	£ 5	..	6½%	7 %	7 %	6½ — 7	6½ — 7	..	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£ 5	14½%	14½%	14½%	12½%	9 — 10	9 — 10	..	..	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	£ 5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..
150,000	Do. do. 3½ % Deb. Stock Red.	100 3½%	3½%	3½%	3½%	3½%	96 — 98	96 — 98	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£ 5	2½%	4 %	4 %	4 %	2½ — 2⅝	2½ — 2⅝	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock 4 %	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..
65,000	South London Electricity Supply, Ord.	£ 5	1⅜%	3 %	4 %	4 %	3 — 3½	3 — 3½	65/-	..	..
103,700	South Met. Elec. Lt. & Power (Ord.	£ 1	Nil	Nil	Nil	2½%	3/32 — 5/32	3/32 — 5/32	..	..	..
85,368	*(Late Blackheath and Greenwich* 7 % Pref.	£ 1	Nil	7 %	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..
148,292	*Dist. E.L.Co.)* 4½ % 1st Deb. Stk.	100 4½%	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
50,000	Urban Electric Supply, Ord.	£ 5	5 %	5 %	5 %	5 %	4⅛ — 4⅜	4⅛ — 4⅜	..	..	..
30,000	Do. do. 5 % Cum. Pref.	£ 5	5 %	5 %	5 %	5 %	4 13/16 — 5 1/16	4 13/16 — 5 1/16	..	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	102 —104	102 —104	..	..	..
110,000	Westminster Electric Supply, Ord.	£ 5	12 %	13⅓%	14 %	13 %	9½ — 10½	9½ — 10½	..	..	..
28,151	Do do. 4½ % Cum. Pref. (Originally 5 %—Red. to 4½ % from 31st Dec., 1905.)	£ 5	5 %	5 %	5 %	5 %	5 5/16 — 5 5/16	5 5/16 — 5 5/16	5 5/32	5⅛	..

Shares not officially quoted :—Mackay Companies, ord., 65—66. Pref. 75—76.
† Unless otherwise stated all shares are fully paid. § Interim dividends.

(Bank rate of discount 3½ per cent. (April 5th, 1906).

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING MARCH, 1906.

The returns of the electrical imports and exports for the month of March practically reverse the relative positions held by these two sections in the previous month.

The respective totals of the two months were as follows:—March: Exports, £157,196; imports, £147,190, and re-exports, £13,337. February: Exports, £116,471; imports, £170,109, and re-exports, £12,703. Whereas the February total of imports was higher than at any time in the preceding 12 months, the March export total of £157,196 is now similarly placed, while the value of the imports has dropped to some £10,000 below that figure—a value, however, still well above the past year's average.

The value of the re-exports, £13,337, is higher than the February total, which also constituted a record for the preceding 12 months.

Compared with the values recorded for March, 1905, all three sections show very favourable increases, the exports in particular amounting to some £43,000 more.

A most gratifying increase in value, amounting to some £27,000, is apparent in cable exports, while the corresponding imports show some decline; the same tendency is shown in regard to electrical machinery, where the exports are some £5,000 to the good, and the imports approximately £18,000 less.

Our imports of telegraphic and telephonic material were somewhat higher than in February, Sweden and Belgium contributing roughly £30,000 worth of such goods out of the total of £33,027.

No marked changes are shown in the prominent purchasing and importing countries.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Country receiving exports and importing.	Electrical goods and appliances.	Electrical cable.	Electric lighting fittings and accessories.	Electric lamps.	Electric meters and instruments.	Electric machinery.	Batteries and accumulators.	Carbons.	Telegraph and telephone material and electric bells.	Electrically-driven machinery.	Tramways apparatus and materials.
	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark	166	22,561	370	14	75	1,555	...	...	...	40	...
Germany	100	...	...	...	24	635	...	...	...	380	...
Netherlands	25	152	247	68	...	187	...	...	...	...	...
Dutch Borneo	71	...	12	...	...	23	...	...	...	...	...
Belgium	285	135	91	5	14	163	10	10	326	...	...
France	154	...	133	12	...	1,064	279	...	...	107	...
French Indo-China	...	...	20	...	...	...	...	...	...	...	...
Portugal, Madeira and Portuguese Africa ...	219	80	1,374	35	24	363	21	7	3	...	...
Spain and Canary Isles	105	197	2	22	17	390	11	...	36	137	...
Italy and Austria-Hungary	38	...	...	...	...	226	...	...	...	59	...
Roumania	10	...	...	...	...	147	...	...	...	...	...
Egypt and Tunis	214	28	277	38	...	225	98	...	110	28	...
China and Siam	153	3,853	513	443	18	147	74	...	22	17	500
Japan	604	5,576	316	51	499	5,384	...	219	742	8,684	...
U.S.A., Philippine Is. and Cuba	73	1,096	68	577	6	...	208	12	...	...	...
Mexico and Panama	...	...	146	3	...	250	...	...	...	...	...
Colombia, Peru and Uruguay	...	8	...	28	...	80	...	...	...	15	...
Chili	18	111	578	26	10	1,689	9	...	48	105	...
Brazil	545	533	112	236	20	209	...	...	77	5	...
Argentine	1,252	3,199	265	719	750	2,230	987	23	1,398	1,354	...
Channel Isles, Gibraltar and Malta	662	1,605	403	...	22	219	...	...	20	2,920	...
British West Africa and St. Helena	10	...	...	...	...	7	...	...	36	...	...
Cape of Good Hope	665	3,687	764	98	262	878	175	30	6	...	...
Natal	1,040	4,615	1,482	664	278	7,859	75	28	148	552	...
Zanzibar, Mauritius and Aden	3	...	1,572	...	6	...	...	...	14	...	...
India	4,449	1,119	2,258	702	1,045	6,349	192	247	83	4,028	812
Burmah	255	353	11	...	...	46	...	...	...	...	...
Ceylon	180	23	121	...	...	13	53	...	...	...	...
Straits Settlements and British N. Borneo ...	192	12	562	123	6	98	48	48	57	...	...
Hong Kong	435	...	277	14	...	180	...	...	11	...	...
West Australia	182	1,207	647	187	156	1,942	15	...	15	...	...
South Australia	100	...	182	25	...	...	27	...	...	...	...
Victoria	166	1,104	155	8	...	1,838	154	...	188	...	...
New South Wales	1,989	665	521	254	11	672	254	...	151	26	...
Queensland and Tasmania	...	744	69	...	...	35	...	...	...	...	...
New Zealand	380	4,433	597	21	...	332	2	...	...	...	1,056
Canada	37	...	104	31	22	...	...	...	31	...	...
British West Indies and British Guiana	62	...	31	...	...	81	7	...	21	...	...
Total, £	14,844	57,196	14,280	4,404	3,265	35,516	2,699	624	3,543	18,457	2,368

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	
Russia, Norway, Sweden and Denmark ...	18	371	...	129	22	2,535	92	22	13,292	...	...
Germany	5,225	10,078	455	204	86	11,417	322	777	2,554	...	...
Holland	1,846	7,725	197	4,954	52	1,133	97	7,240	437	...	...
Belgium	1,639	1,570	19	3,108	31	7,417	37	1,121	16,701	7	...
France	1,132	6,638	1,364	1,132	1,414	1,377	1,377	2,782	17	...	...
Italy	...	53	...	...	650	...	...	...	...	...	...
United States	3,140	623	566	221	...	21,144	64	243	26	297	...
Total, £	13,000	27,058	2,601	9,748	2,255	45,023	1,989	12,185	33,027	304	...

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	
Various countries, mainly as above	1,718	6	109	787	32	2,660	62	125	7,251	587	...

TOTAL EXPORTS: £157,196

TOTAL RE-EXPORTS: £13,337

TOTAL IMPORTS: £147,190

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

THE ADVANTAGES OF EMPLOYING ELECTRICAL ENGINEERING NOMENCLATURE IN STEAM ENGINEERING CALCULATIONS.

By H. M. HOBART.

On the Continent, the kilogramme-degree (Centigrade) calorie is universally employed as a unit of heat energy. In Great Britain and in America, the use of the B.TH.U. (pound-degree Fahrenheit) is nearly equally universal. Inasmuch as neither of these units is, at any rate for the electrical engineer, so convenient as the KW.-hour, it is fairly probable that the latter will, in the course of time, displace them both. The Fahrenheit scale has been practically discarded on the Continent, and also by many engineers in Great Britain and America, and it is certainly a matter of but a comparatively short time before the use of the Centigrade temperature scale will be practically universal. Considerable opposition to the introduction of the kilogramme as the unit of weight is manifested in English-speaking countries, and hence it is well to use the metric ton of 1,000 kilogrammes (2,204 lb.) wherever practicable, since this is only 1·5 per cent. smaller than the British ton of 2,240 lb. In most engineering work, one can ignore the 1·5 per cent. difference in weight between the metric and the British ton. For cases where greater exactness is required, it is preferable to use the metric ton; but it will generally be amply specific to employ briefly the term ton.*

If, therefore, we take the ton as the unit of weight, we have a thoroughly practical international unit of weight, and, in the interests of obtaining the advantages of a decimal system, we shall take the one-thousandth part of a ton, when a smaller unit of weight than the ton is more convenient. This one-thousandth part of a ton is thus equally suitable for an international unit, but since it happens to be called a kilogramme in certain countries and has not been provided with an alternative name in the English language, it will save trouble to adopt the name of kilogramme. Thus:—

1 kilogramme = 0·001 ton.
1 ton = 1,000 kilogrammes.†

The first step in steam engineering is to consider the question of raising the steam. When this is accomplished by burning coal under a boiler, we shall wish to know the energy of combustion (or calorific value) of the coal.

The coals available for this purpose range in calorific value from 9,500 KW.-hours per ton downwards; 8,700 KW.-hours per ton being a readily obtainable value. This value represents the heat energy obtained by burning 1 ton of coal in the presence of a suitable supply of air.

Could we transfer this heat energy at 100 per cent. efficiency into electrical energy of suitable voltage, we could run 30 16-C.P. high efficiency incandescent lamps for one year, with the energy obtainable by the combustion of 1 ton of coal. Owing to the losses in transformation, we only obtain sufficient electrical energy for from two to three lamp-years. As another example of the energy contained in a ton of coal with a calorific value of 8,700 KW.-hours, we may notice that this energy is sufficient to lift a weight of 1 ton through a height of just about 2,000 miles. A still further illustration of the amount of energy contained in a ton of coal of a calorific value of 8,700 KW.-hours may be found in the statement that it is about equal to the amount of energy consumed by an ordinary urban tramcar of 12 tons weight in traversing 7,000 miles of average urban route at a schedule speed of six miles per hour and with four stops per mile, the equipment including ordinary continuous current series-wound motors with series-parallel control. That, in actual practice, a ton of coal is consumed for every 500 car-miles or so, is due to the fact that some 93 per cent. to 96 per cent. of the energy of combustion of the coal is transformed into irrecoverable heat energy in the course of the various transformations of energy occurring between the coal pile and the trolley wheel.

In burning 1 ton of good coal under a good boiler, we may transfer to the contents of the boiler 75 per cent. or more of the energy of combustion. To calculate the effect we must first consult Table I, in which are given values for the energy absorbed in KW.-hours in raising 1 ton of water from 50° C. to the boiling point at various absolute pressures and in evaporating it at those pressures, and in superheating it 50° C. or 100° C., as may be required.

Table I.

Boiler pressure absolute in kg. per sq. cm., *i.e.*, in metric atmospheres.	KW.-hours per ton of steam raised from feed water at a temperature of 50° C. Amount of superheat in degrees Centigrade.	
	50° C.	100° C.
8	743	776
10	748	781
12	752	786
14	756	791
16	759	795
18	761	798

The preparation of Table I draws attention to another point, namely, the very convenient method used in Continental countries of denoting as one metric atmosphere a pressure of 1 kilogramme per square centimetre. It happens that a pressure of 1 kilogramme per square centimetre is, so far as relates to its general order of magnitude, equal to a pressure of 1 atmosphere. Since a pressure of 1 atmosphere is a function of altitude and humidity, it is an excellent plan to discard it for this definite fixed nominal value, which is 1 kilogramme ($\frac{1}{1000}$ of a ton) per square centimetre. For the convenience of engineers more accustomed to other systems, there are given in Table II (p. 695) the equivalent values of the boiler pressures in British units.

From the values in Table I we may readily deduce Table III, which shows the tons of water evaporated per

Table III.—Showing for Various Boiler Efficiencies and Various Coal Qualities, the Tons of Steam Raised per Ton of Coal Burned, as a Function of the Boiler Pressure and Superheat.

Calorific value in kilowatt-hours per ton of coal.		4,000 KW.-H.			5,000 KW.-H.			6,000 KW.-H.			7,000 KW.-H.			8,000 KW.-H.			8,500 KW.-H.			9,000 KW.-H.			9,500 KW.-H.		
Boiler pressure (absolute) in kgs. per sq. cm.		8 atm.	12 atm.	16 atm.	8 atm.	12 atm.	16 atm.	8 atm.	12 atm.	16 atm.	8 atm.	12 atm.	16 atm.	8 atm.	12 atm.	16 atm.	8 atm.	12 atm.	16 atm.	8 atm.	12 atm.	16 atm.	8 atm.	12 atm.	16 atm.
Boiler efficiency.	Superheat.	Tons of steam.			Tons of steam.			Tons of steam.			Tons of steam.			Tons of steam.			Tons of steam.			Tons of steam.			Tons of steam.		
60%	50° C.	3·23	3·19	3·16	4·04	3·99	3·95	4·84	4·78	4·74	5·65	5·58	5·53	6·46	6·38	6·32	6·86	6·78	6·71	7·26	7·18	7·11	7·67	7·58	7·50
	100° C.	3·10	3·05	3·02	3·87	3·81	3·77	4·65	4·57	4·53	5·42	5·34	5·28	6·20	6·10	6·04	6·58	6·48	6·41	6·96	6·86	6·79	7·35	7·25	7·17
65%	50° C.	3·50	3·46	3·43	4·38	4·32	4·28	5·25	5·19	5·13	6·13	6·05	6·00	7·00	6·92	6·85	7·43	7·35	7·28	7·87	7·78	7·71	8·31	8·22	8·14
	100° C.	3·36	3·31	3·27	4·20	4·14	4·09	5·04	4·97	4·90	5·88	5·79	5·72	6·72	6·62	6·54	7·14	7·04	6·95	7·56	7·45	7·36	7·98	7·86	7·76
70%	50° C.	3·77	3·72	3·68	4·71	4·65	4·60	5·65	5·58	5·52	6·60	6·51	6·44	7·54	7·44	7·36	8·00	7·91	7·81	8·48	8·36	8·29	8·95	8·83	8·74
	100° C	3·61	3·56	3·52	4·51	4·45	4·40	5·42	5·34	5·28	6·31	6·23	6·16	7·22	7·12	7·04	7·67	7·56	7·48	8·12	8·01	7·92	8·57	8·45	8·36
75%	50° C.	4·04	3·99	3·95	5·05	4·99	4·94	6·06	5·98	5·93	7·07	6·98	6·91	8·08	7·98	7·90	8·59	8·47	8·40	9·10	8·98	8·89	9·61	9·48	9·33
	100° C.	3·87	3·81	3·77	4·84	4·76	4·71	5·8	5·72	5·66	6·77	6·67	6·60	7·74	7·62	7·54	8·23	8·10	8·01	8·70	8·56	8·48	9·18	9·05	8·95
80%	50° C.	4·30	4·25	4·21	5·37	5·31	5·26	6·45	6·38	6·31	7·53	7·44	7·36	8·60	8·50	8·42	9·14	9·04	8·95	9·68	9·56	9·48	10·2	10·1	10·0
	100° C.	4·12	4·06	4·02	5·15	5·07	5·03	6·18	6·09	6·04	7·21	7·11	7·04	8·24	8·12	8·04	8·76	8·64	8·55	9·27	9·13	9·05	9·80	9·63	9·55

* It must be kept in mind that the ton generally employed in America is about 10 per cent. smaller, and equals a weight of only 2,000 lb. (909 kilogrammes). The use of this value for the ton should be discontinued, since not only has it no justification as a rational unit, but it has rarely been employed in other countries.

† Incidentally it may be of interest to recollect that 1 ton is the weight of a cubic metre of water.

Table IV.

	Cost (delivered on site) in shillings per ton of coal of a calorific value of 8,700 KW.-hours per ton.	Outlay for fuel (in shillings per ton of steam raised) in producing (from feed water at 50° C.) steam at an absolute pressure of 13 kg. per sq. cm. and 50° C. superheat.	Cost of coa in pence per kilowatt-hour (absolute pressure of steam 13 kg. per sq. cm. 50° C. superheat feed water 50° C.) at a steam consumption of 6	8	10	12	14	16	18	20 kilogrammes per KW.-hour.
For a boiler efficiency 60%	4s.	0·57	·041	·055	·069	·083	·097	·110	·124	·138
	5s.	0·71	·052	·069	·086	·103	·121	·138	·155	·175
	6s.	0·86	·062	·083	·104	·124	·145	·166	·186	·207
	7s.	1·01	·072	·097	·121	·145	·169	·193	·217	·242
	8s.	1·15	·083	·110	·138	·166	·193	·221	·248	·276
	9s.	1·30	·093	·124	·155	·187	·217	·248	·280	·310
	10s.	1·44	·104	·138	·173	·207	·241	·276	·310	·345
	11s.	1·58	·114	·152	·190	·228	·266	·304	·342	·379
	12s.	1·72	·124	·166	·207	·249	·290	·331	·373	·414
	13s.	1·87	·134	·180	·224	·269	·314	·359	·404	·448
	14s.	2·02	·145	·193	·242	·290	·338	·386	·435	·483
	15s.	2·16	·155	·207	·259	·311	·362	·414	·466	·517
	16s.	2·30	·165	·221	·276	·331	·386	·441	·497	·552
For a boiler efficiency 65%	4s.	0·53	·039	·051	·064	·077	·090	·103	·115	·128
	5s.	0·66	·048	·064	·080	·096	·112	·128	·144	·162
	6s.	0·81	·058	·077	·096	·116	·135	·154	·173	·193
	7s.	0·94	·067	·090	·112	·135	·157	·180	·202	·225
	8s.	1·07	·077	·103	·128	·154	·180	·206	·231	·257
	9s.	1·21	·087	·115	·144	·174	·202	·230	·260	·289
	10s.	1·34	·097	·128	·160	·193	·224	·256	·288	·320
	11s.	1·47	·106	·141	·176	·212	·247	·283	·317	·352
	12s.	1·61	·116	·154	·192	·231	·268	·308	·346	·385
	13s.	1·74	·125	·167	·208	·250	·292	·335	·375	·416
	14s.	1·87	·135	·180	·224	·270	·314	·360	·404	·449
	15s.	2·00	·144	·192	·240	·289	·336	·386	·433	·481
	16s.	2·13	·154	·205	·256	·308	·358	·412	·462	·513
For a boiler efficiency 70%	4s.	0·49	·036	·047	·059	·071	·083	·095	·106	·118
	5s.	0·61	·044	·059	·074	·089	·103	·118	·133	·148
	6s.	0·74	·053	·071	·089	·107	·124	·142	·160	·178
	7s.	0·86	·062	·083	·103	·124	·145	·166	·186	·207
	8s.	0·98	·071	·095	·118	·142	·166	·190	·213	·237
	9s.	1·11	·080	·106	·133	·160	·187	·213	·240	·266
	10s.	1·23	·089	·118	·148	·178	·207	·237	·267	·295
	11s.	1·35	·098	·130	·162	·195	·228	·261	·294	·325
	12s.	1·47	·107	·143	·177	·213	·249	·285	·320	·355
	13s.	1·60	·115	·154	·192	·231	·269	·310	·346	·385
	14s.	1·72	·124	·166	·207	·249	·290	·334	·373	·415
	15s.	1·84	·133	·177	·222	·266	·310	·357	·400	·444
	16s.	1·96	·142	·189	·236	·284	·331	·380	·426	·474
For a boiler efficiency 75%	4s.	0·46	·033	·044	·055	·066	·078	·089	·100	·111
	5s.	0·58	·041	·055	·069	·083	·097	·110	·125	·139
	6s.	0·69	·050	·067	·083	·100	·116	·133	·150	·167
	7s.	0·81	·058	·078	·097	·116	·136	·155	·175	·194
	8s.	0·92	·066	·089	·111	·133	·156	·178	·200	·222
	9s.	1·04	·075	·100	·125	·150	·175	·200	·225	·250
	10s.	1·15	·083	·111	·138	·166	·194	·222	·250	·276
	11s.	1·26	·091	·122	·152	·183	·213	·244	·275	·304
	12s.	1·38	·100	·133	·167	·200	·234	·267	·300	·333
	13s.	1·50	·108	·144	·180	·216	·242	·290	·325	·362
	14s.	1·61	·116	·155	·194	·234	·272	·311	·350	·389
	15s.	1·72	·124	·166	·208	·250	·292	·333	·375	·416
	16s.	1·84	·133	·177	·222	·266	·353	·355	·400	·444
For a boiler efficiency 80%	4s.	0·43	·031	·041	·052	·062	·072	·083	·093	·103
	5s.	0·54	·039	·052	·065	·078	·091	·104	·116	·130
	6s.	0·64	·046	·061	·078	·093	·109	·124	·139	·155
	7s.	0·75	·054	·072	·091	·109	·127	·145	·162	·182
	8s.	0·86	·062	·083	·104	·124	·145	·166	·186	·206
	9s.	0·96	·070	·093	·117	·140	·163	·186	·210	·233
	10s.	1·08	·078	·103	·130	·155	·181	·206	·234	·260
	11s.	1·18	·085	·114	·143	·171	·200	·227	·257	·285
	12s.	1·29	·093	·124	·156	·186	·218	·248	·280	·310
	13s.	1·40	·101	·135	·169	·203	·236	·269	·304	·337
	14s.	1·50	·109	·145	·182	·218	·254	·290	·327	·364
	15s.	1·61	·116	·156	·195	·233	·272	·311	·350	·390
	16s.	1·72	·124	·166	·207	·248	·290	·331	·372	·414

ton of coal of various qualities, and for boiler efficiencies of 60 per cent., 65 per cent., 70 per cent., 75 per cent., and 80 per cent., and for various pressures and superheats.

Since we may obtain from Table III the number of tons of steam raised per ton of coal burned, for boiler efficiencies of 60 per cent. to 80 per cent. and for given pressures and amounts of superheat, it is a simple step to deduce the fuel cost for producing one ton of steam when burning coal of a given price per ton and a given calorific value. Fuel costs thus derived are entered up in the second column of Table IV, for steam-raising plants of from 60 to 80 per cent. efficiency, burning coal of a calorific value of 8,700 KW.-hours per ton, and costing, delivered on site, from 4s. to 16s. per ton.

Steam-driven generating sets consume, according to circumstances, from 6 to 20 kilogrammes (thousandths of a ton) of steam per KW.-hour of output from the dynamo. The circumstances affecting the steam consumption per KW.-hour delivered, excluding the question of type and design, relate mainly to the average percentage of rated load at which the plant operates during the period considered, and to the conditions of admission pressure, superheat and vacuum. Space will not permit of entering upon the consideration of these points. Assuming that the mean steam consumption per KW.-hour delivered is known, we may, for the prices and quality of coal, and the boiler efficiencies considered, obtain from the right-hand section of Table IV, the fuel cost in pence per KW.-hour delivered from the dynamo. For coal of any other calorific value, the fuel cost will be in the inverse ratio of the calorific values. Thus for the following case :—

Mean boiler efficiency = 70 per cent.,
Cost of coal = 10s. per ton,
Mean steam consumption = 9 kg. per KW.-hour,
Calorific value of coal = 7,000 KW.-hours per ton,

we obtain a fuel cost of $\frac{8,700}{7,000} \times \frac{0{\cdot}118 + 0{\cdot}148}{2}$,

$= 1{\cdot}24 \times 0{\cdot}133$,
$= 0{\cdot}165$d. per KW.-hour.

(*To be concluded.*)

Table II.

Absolute pressure in kilogrammes per square centimetre.	Absolute pressure in atmospheres; taking 1 atm. as corresponding to a barometric pressure of 760 mm. mercury.	Pressure in lb. per sq. in. Absolute.	Pressure in lb. per sq. in. Gauge 1 atm. = 760 mm. mercury.	Absolute pressure in kilogrammes per square centimetre.	Absolute pressure in atmospheres; taking 1 atm. as corresponding to a barometric pressure of 760 mm. mercury.	Pressure in lb. per sq. in. Absolute.	Pressure in lb. per sq. in. Gauge 1 atm. = 760 mm. mercury.
1·00	0·97	14·2	−0·5	11·00	10·67	156·2	141·5
1·03	1·00	14·7	0	11 33	11·00	161·7	147·0
2·00	1·94	28·4	13·7	12·00	11·64	170·4	155·7
2·06	2·00	29·4	14·7	12·36	12·00	176·4	161·7
3·00	2·91	42·6	27·9	13 00	12·61	184·6	169·9
3·09	3 00	44·1	29·4	13·39	13·00	191·1	176·4
4·00	3·88	56·8	42·1	14·00	13·58	198·8	184·1
4·12	4·00	58·8	44·1	14·42	14·00	205·8	191·1
5·00	4·85	71·0	56·3	15·00	14·55	213·0	198·3
5·15	5·00	73·5	58·8	15·45	15·00	220·5	205·8
6·00	5·82	85·2	70·5	16·00	15·52	227·2	212·5
6·18	6·00	88·2	73·5	16·48	16·00	235·2	220·5
7·00	6·79	99·4	84·7	17·00	16·49	241·4	226·7
7·21	7·00	102·9	88 2	17·51	17·00	249·9	235·2
8·00	7·76	113·6	98·9	18·00	17·46	255·6	240·9
8·24	8·00	117·6	102·9	18·54	18·00	264·6	249·9
9·00	8·73	127·8	113·1	19·00	18·43	269·8	255·1
9·27	9·00	132·3	117·6	19·57	19·00	279·3	264·6
10·00	9·70	142·0	127·3	20·0	19·4	284·0	269·3
10·30	10·00	147·0	132·3	20·6	20·0	294·0	279·3

Tube Bending Machine.—Mr. Charles Taylor, of Bartholomew Street, Birmingham, is exhibiting at the National Engineering and General Trades Exhibition which is open at Bingley Hall, until June 9th next, the Kennedy tube bender which has already been described in our pages. Mr. Kennedy is in attendance giving demonstrations.

For Motorists and Others.—We have received from Mr. Eden W. Paget, the secretary of the Road Club, 8, Clarges Street, Piccadilly, W., a copy of the revised prospectus of the Road Club, which contains the latest particulars of the club's programme, and a complete list of vice-presidents. We understand that very considerable progress has already been made in providing comfortable quarters for the club in all parts of the country, in anticipation of the touring season. There is stated to have been forthcoming conclusive evidence of the great need which exists for an organisation of this kind. Fuller particulars can be obtained on application to Mr. Paget.

PROCEEDINGS OF INSTITUTIONS.

The Distribution of Magnetic Induction and Hysteresis Loss in Armatures.

By Dr. W. M. Thornton, M.I.E.E.

(*Abstract of Paper read before the* Institution of Electrical Engineers *at Newcastle, February 26th*, 1906.)

The study of magnetic distribution in armatures and poles is important for several reasons. The source and incidence of copper loss is now very well known, but this cannot be said with equal truth of the iron loss, whether it occurs by eddy currents or by hysteresis. The success or failure of commutation depends on the induction in the teeth and outer layers of the core, hysteresis and eddy current losses depend equally upon the distribution in the

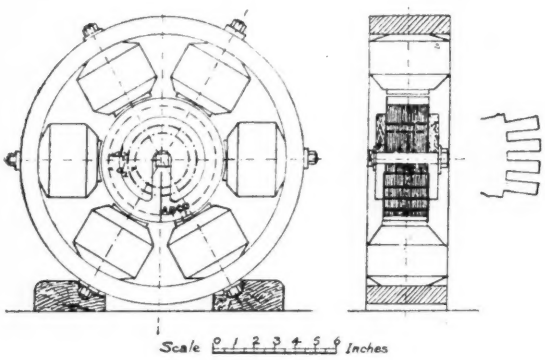


Fig. 1.—Experimental Magnetic Circuit.

deeper parts. Economy of material and reduction of weight require that the radial depth of the core should be as small as possible; whilst, on the other hand, if it is made too small the full magnetism cannot enter, and the leakage coefficient increases.

The result of a preliminary examination of the simplest case of a solid smooth-core armature was given in a former paper [an abstract of which appeared in the Electrical Review, October 7th, 1904]. The present paper contains an examination of the cases of toothed cores, hollow and solid, by the method of the previous paper, using search coils wound in small holes drilled through the core parallel to the shaft. When the magnetising circuit is made or broken, the inductive change through each of these in turn is observed by means of a ballistic galvanometer. To avoid the disturbing effect of residual magnetism, a powerful alternating current is passed through the field winding before each reading is taken.

The experimental arrangement and the results obtained are shown in figs. 1, 2, 3 and 4.

The most distinctive feature of these curves, when compared with the results of the previous paper, is that the flux density in almost every case decreases from the bottom of the teeth inwards. The exceptions are the curves of fig. 2, where the core is solid, in which case at the lowest inductions the fall towards the periphery characteristic of the smooth core curves is again apparent. The reason for this droop is that the leakage from the pole tips is less at the lower densities, and the lines which do enter the teeth from the leakage fringe pass in nearly straight lines under the teeth across to the next pole. In machines with a larger number of poles this will not be so marked.

The next point, which is more readily seen by placing together the curves of figs. 2, 3 and 4, which correspond to the same gap density, is that as the radial depth is reduced the flux densities in the deeper parts are increased relatively to those at the outer. In no case, however, even with the most shallow cores and at low flux densities, does the inner density equal the outer, the nearest value being 0·7 of the maximum for the lowest curve in fig. 4.

All these curves, it will be noted, give the distribution across a radial section midway between the poles. If, however, the test is repeated with the plane of the armature search coils rotated to positions B, C, D (fig. 1), the curves not only are steeper near the teeth, but bend upwards at the inner boundary also, as shown in figs. 5, 6 and 7, so that in these cases the density is least at a distance of about half the depth from the bottom of the teeth. The immediate consequence of making the core too shallow is to reduce the area and increase the reluctance. The increase of leakage between the poles is well shown in the photographs of interpolar induction which are given in the paper. These were taken by Prof. Hele-Shaw's method of observing stream lines in viscous fluids, which has been fully described in a paper before the Institution.

To illustrate the nature of the distribution, the stream line method is very helpful, though it is impossible to represent the automatic change of permeability from point to point. It is, however, possible, as will be shown later, to work with three or more permeabilities in the same slide, as, for example, in poles, air-gap, teeth and armature core. To do this, a special narrow tool was made and clamped to the planing machine used in preparing the wax slides. Taking care to have its cutting edge quite straight and parallel to the face plate, large and small surfaces could be planed which did not afterwards distort the lines of flow in any way.

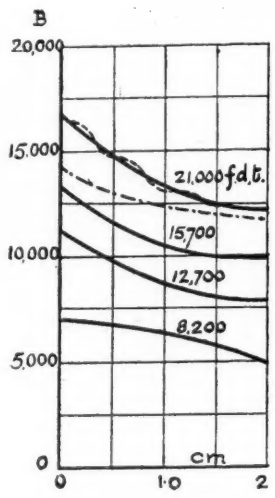


Fig. 4.—Position A.

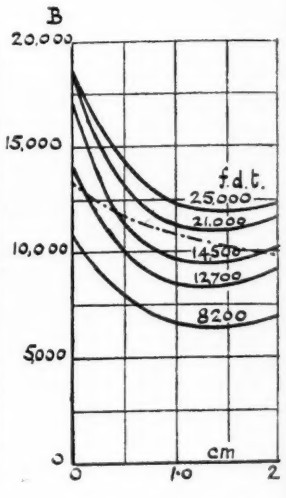


Fig. 5.—Position B.

In order to represent actual conditions as closely as possible, some slides were made with teeth and poles of different thicknesses imitating the sequence of permeabilities met by the flux in crossing the gap. The refraction of the lines in the fringe in their attempt to reach the core, and the nature of the interpolar induction, as compared with smooth cores, are of most interest. The permeabilities in all the cases of smooth and slotted cores being fixed, very little change is made by an alteration of the pressure on the slide or the velocity of flow. The hydro-dynamical method, therefore, corresponds to the cases where the induction density is so high that there is saturation in the iron—that is, to the highest curves in figs. 2, 3 and 4. There is an interesting feature which appears in the curves, whether from the direct experiment or from the photographs of stream lines. In drawing the highest curves of figs. 2 and 3, it was noticed that they had a wavy appearance. The meaning of this was not clear at the time; but when the stream line curves came to be drawn, it was found that the same feature appeared, and it was then traced to the action of the teeth. It may even be seen without measurement that in some of the

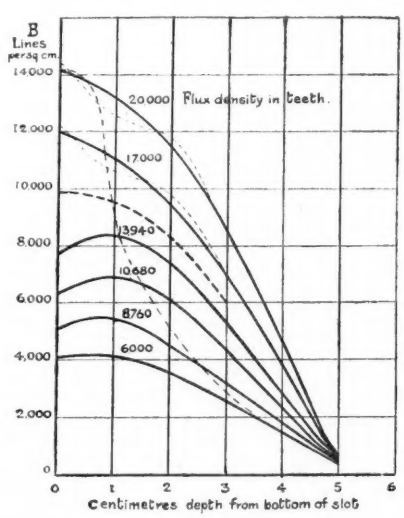


Fig. 2.—Densities in Toothed Solid Core.

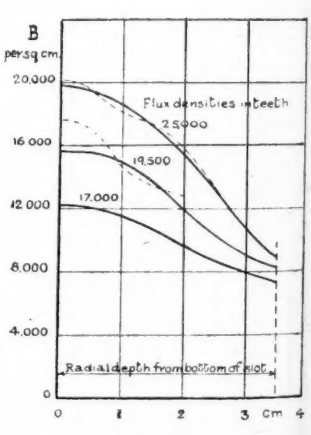


Fig. 3.—Densities in Toothed Hollow Core.

stream-line diagrams the lines which pass through the teeth into the core are denser than those which are in line with the slot. This difference of density may be followed through the core to the opposite pole. The induction, in fact, at high densities lies in streaks in the part of the core below the teeth. This might be expected to be more marked in alternators where the teeth and

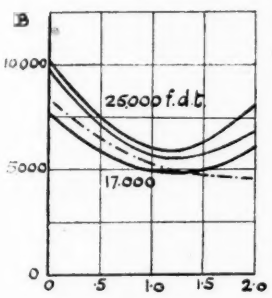


Fig. 6.—Position C.

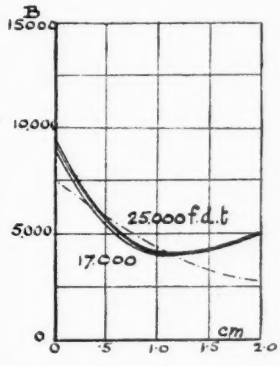


Fig. 7.—Position D.

slots per pole are fewer, but it only occurs at high induction densities. The fact that it does so is an indirect proof of the statement previously made, that the stream-line curves correspond to cases of high densities in the iron.

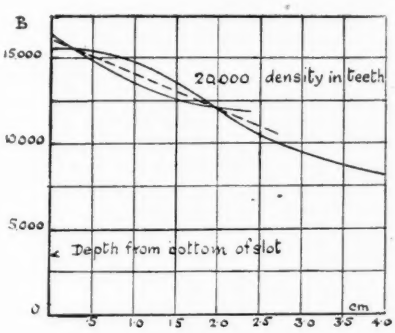
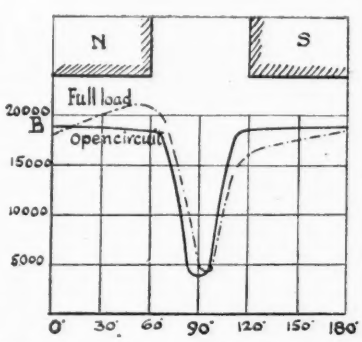
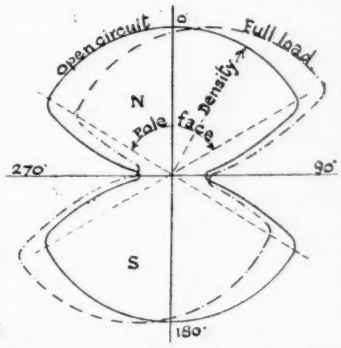


Fig. 8.—Average Fall of Density in Core.





Figs. 9 and 10.—Distribution of Density in Teeth between Poles.

It was shown at the conclusion of the previous paper that with smooth cores, when the ratio of radial depth to radius is half the number of poles, the flux density at the inner boundary is about half the maximum value in the core, at a section midway between the poles. To compare the case of slotted cores, we may take figs. 3 and 4 as representing working conditions. The ratio of radial depth to radius in fig. 3 is 0·46 and in fig. 4 0·264. The former is, therefore, too deep and the latter too shallow for the above rule. The mean of these distributions when there is a flux density of 20,000 in the teeth is shown in fig. 8, and is practically a straight line from 11,000 lines per sq. cm. inside to 16,000 at the bottom of the teeth, a ratio of minimum to maximum of ·687. Thus if, in designing a machine, the induction in the core is assumed to be uniform at 13,500 lines per sq. cm., the departure from this would be 18 per cent. above and below, so that the mean density is 82 per cent. of the maximum. The flux density just below the teeth in fig. 3 is, on an average, ·75 of that in the teeth measured at right angles to the lines under a slot. That in fig. 4, with a shallow core, is ·85 of the tooth density. The mean of these would very probably correspond to most working cases. In order, then, to find the distribution in a slotted core at a position midway between the pole-tips, or on the neutral magnetic line if the machine is on load, take ·8 of the mean density in the teeth and ·82 of this; the result, or 65 per cent. of the teeth density, will be the mean density in the core. With ratios of radial depth to radius greater than ·33, the mean value is less than this, and in general varies inversely with the ratio.

The loss by hysteresis in an armature may be dealt with in two parts—teeth and core. So long as the number of lines in a tooth does not change—as, for example, in passing under a pole—there is no dissipation of energy. Approaching the pole tip, the lines become oblique, and midway between the poles horizontal, though the density never drops to zero. There is, therefore, a rotating magnetisation in the teeth which is at the same time fluctuating between limits which can be found from the photographs.

There have been many calculations of loss based on assumptions as to the manner in which the teeth density changes, but all assume an alternating flux. The fact that, as shown by the photographs, it is rotating is likely to reduce the estimate of hysteresis loss in teeth, which, though too small to affect efficiency to any marked extent, does influence the temperature of the insulation of the armature conductors. The loss cannot in any case follow Steinmetz's law as generally assumed.

When the machine is on load, the distribution of the lines in the gap being somewhat changed, there is also a variation of density in the teeth from point to point under the pole, though there is no rotation. The effect is to shear the distribution over, as in figs. 9 and 10. For all practical purposes, the hysteresis loss in the teeth may be considered to be unaffected by the change. The fact that the loss by rotating magnetisation decreases after reaching a maximum contributes to this.

In the foregoing the change of density from top to bottom of the tooth has not been considered as affecting hysteresis loss. On approaching and leaving the pole tips, the distribution of flux becomes more uniform in the teeth, and since the molecular movement is confined to the interpolar space, this change of density will not make any marked difference.

The hysteresis loss in the parts of the core below the teeth also depends on the manner in which the cycle of magnetisation is carried through at each point. There is, however, much less variation than in the teeth.

The work was originally undertaken to obtain material by which the ratio of hysteresis to eddy-current loss in armatures could be found. It was felt that this could not be done with any confidence until the induction density at every part of the core throughout the cycle was known. The experiments described, though leaving many questions unanswered, as, for example, the influence of closing the slots, at least serve to indicate the nature and magnitude of the results to be expected in machines on a large scale. The eddy current loss has not yet been fully worked out.

The results in the paper may be summarised as follows:—The magnetisation of the teeth in slotted armatures is not alternating but rotating, and at the same time fluctuating; that of the core is rotating, but by reason of the distribution of density in the core not being uniform, it is unevenly distributed, being greatest at the outer parts below the teeth. The ratio of the mean dissipation coefficient to that corresponding to the mean density is about 0·8. The coefficient for the teeth alone is about 0·00105 joule per cubic centimetre per cycle; that for the core 0·00108. The low value for the teeth is caused by the drop in density between the poles, and by the fact that it is rotating.

Cost of Electricity from Private Electrical Plants.

Mr. W. Emmott opened the discussion on Mr. W. Hartnell's paper (see Electrical Review, April 6th), and said there was a difficulty in inducing manufacturers and others who had their own plants to see that in many cases it would pay them better to take an outside supply. In very few instances was any debit made to the electricity account in regard to coal or maintenance charges on engines and boilers. He had found many instances where the only debit made was for a renewal of lamps, and this was entered in the accounts as the cost of lighting. The mistake made by Mr. Hartnell throughout his paper of estimating in place of metering the units generated rendered such estimates worse than useless.

Mr. Dickinson wished to emphasise the fact that the figures of costs given were much too low. Regarding example No. 8, he had taken out the load factor for a similar factory at present working from the Leeds supply mains, and found it only 5 per cent., whereas Mr. Hartnell's figures worked out at 10 per cent. The load factor of a similar factory, where the lighting was done from a private plant, was slightly less than 5 per cent. By correcting the load factor and making some slight correction for oil and maintenance, the cost would be nearer 3·56d. than 1·6d. With regard to No. 10, with Mond gas plant in duplicate, his figures were also much too low. He had some figures for a similar sized plant as follows: Maintenance, ·092d. (Mr. Hartnell's figure was ·027d.); oil, ·084d. (Mr. Hartnell's figure was ·012d.). The estimate with the above corrections, instead of being ·619d., worked out at ·756d. With regard to No. 12, if they took coal at 6s. per ton, they would find

that a plant of that size, generating that number of units, would use 17·56 lb. of water per KW.-hour. He did not know of a station in this country that was working at 17·65 lb. of water per KW.-hour throughout the year, and he thought the output ought to be one million units, not two millions. With regard to maintenance, he thought the figure of ·0048d. was absolutely out of the question. The charge for attendance and oil should be at least ·108d. On the basis of these corrections, the figures worked out at ·844d. instead of ·398d. In certain cases there were advantages making it worth while for the manufacturer to take the supply from the local authority, though it was difficult to put a money value on them. It was a curious thing, if power users could get such low figures as the ones quoted, that they changed over to the supply authority. In Leeds they had changed over a number of private installations, some of them with large plants, and were still going on changing.

Mr. WOODHOUSE thought the figures given in the paper were misleading. The value of the examples generally was vitiated by the units being estimated. In Case 3 the cost of the use of a kilowatt worked out at £1 18s. per annum, a figure far below the published results of the working of electrical supply undertakings. In Case 10, a gas engine plant, the maintenance cost was ·017d per unit. This was absurdly low; the Walthamstow gas-driven station had a maintenance cost of ·1d. per unit, which itself was an excellent figure for such plant. Mr. Hartnell's estimated units had been based apparently on the rated output of the dynamos, but such machines were rarely fully loaded, and the load varied throughout the day. An analyis of the total cost of electric power per unit from a suction gas plant appeared in a recent number of *Electrics*, and seemed worth quoting on account of the makers' claim of "power at one-tenth of a penny per horse-power-hour." The capital cost of the plant, including housing, foundations, &c., and erection, was £20 per B.H.P., and the cost of power per horse-power-hour was:—

Interest and depreciation at 10 per cent. ...	·74d.	nearly.
Oil	·05d.	,,
Wages	·37d.	,,
Rates and taxes	·148d.	,,
	1·288d.	
Coal at one-tenth penny per B.H.P.-hour ...	·1d.	
	1·388d.	

The case considered was an engineering shop, and the horse-power hours used per annum were taken as one-quarter of what the plant could supply if working at full load during the whole of the working hours, this being very frequently the case. This was more likely to be a true figure than those estimated by the author.

Mr. PREECE said that what Mr. Hartnell had quoted in his paper, from a manufacturer's point of view, was certainly correct. The central station engineers were in a totally different position. When a manufacturer lighted his works by electricity or drove a portion or the whole of it by electricity, he used his existing engines, boilers, buildings, and everything appertaining thereto. The cost of management, staff, land and buildings was a very small charge indeed on the portion of the works lighted or operated by electricity. He knew of many cases where there had been a reduction of the staff. He knew for an absolute fact places where electricity was generated and a liberal allowance made in every respect which was working out at ½d. per unit. The engines at work in a number of mills were quite comparable with the engines which had been installed in generating stations, and, in fact, many mill-owners were using larger units than station engineers used. He was a great supporter of power companies, but did not believe in taking the thing too far. About five years ago Messrs. Empsall and Firth, Bradford, put in 30 H.P. in motors to operate some 50 to 60 fancy looms; the electricity at 1d. per unit came to £6 10s. per week. Twelve months ago they put in a suction gas plant, costing £500, and the coal bill for the same amount of work was 25s. per week. Messrs. Slingsbys, Bradford, had also adopted suction gas plant in place of electricity, and found the total cost to be one-half with electricity at 1½d. per unit. Messrs. A. H. Briggs, of Russia, also abandoned one portion of their supply at 1½d. per unit, and put in their own generating plant, about 100 H.P. The electricity bill per week, at 1½d. per unit, came to £9 10s. As they had sufficient boiler power, and the cables and motors were already installed, there was nothing to add but the engine, generator and switchboard, and the actual saving came to about £4 per week. In adopting electricity, the financial results must certainly be decided by the man that has to pay the bill.

Mr. ROSLING said that Mr. Hartnell should have allowed something for the switchboard in his capital costs, as a generator board was more expensive than a mere main switch and fuse. In his opinion the point mentioned by Mr. Hartnell of the value of capital employed was of the very greatest importance; the active working machinery had to provide the gross profit to pay the net profit and all other charges, and it was only when the money sunk in electrical plant was debited with a similar percentage that the real cost per unit was obtained. In the examples given, he considered the items for depreciation, interest and maintenance were too low, and the output in kilowatt-hours too high for typical cases; he did not think any figures of kilowatt-hours were of much use unless they were actually metered; the woollen mills mentioned, with the generators running at 90 per cent. of their load, gave a yearly lighting run of about 800 hours, whereas usual practice was only 400 hours. In the last example of a private house plant, it was quite impossible to obtain 4,500 KW.-hours at the accumulator terminals from 160,000 cb. ft. of gas; with 25 cb. ft. of gas per brake-horse-power-hour, and an overall efficiency of belt generator and cells of 50 per cent., 3,200 KW.-hours was the maximum output and in ordinary practice for a plant of this size 2,250 KW.-hours might be considered good practice. This would make the cost 8d. an hour even with the extremely small depreciation figure assumed; from his own experience he was convinced that when running on cells 75 cb. ft. of gas was not too much to allow per kilowatt-hour output from the cells, and the interest and depreciation should be from 17½ per cent. to 20 per cent. He thought the most valuable feature in the paper was the striking way the relative values of fuel and capital charges were shown in the tables; in really economical plants the fuel cost was a mere trifle compared to the capital charges.

Mr. HEATON said that the figures in the paper in the first example were taken from actual facts. The dynamo had been working for about 14 years, and during the whole of that period it had not had the least repair done to it. With regard to running the plant, he noticed Mr. Hartnell gave 60 tons of coal at 7s. As a matter of fact, there was no extra coal required for working the dynamo. With regard to the cost per unit given as ·25d., it was really less than half that. In a woollen mill in Leeds the dynamo which was put in for lighting purposes required 42 to 45 H.P. to drive it, and was driven by a separate steam engine. The cost of lighting with gas had been about £250 per year. The coal used before the lighting plant was put in cost £40 a week, and this quantity had not increased after the lighting plant had got to work. Therefore the only cost to which the manufacturer was put was what he allowed for interest and depreciation on the plant that was put down, but that was a small item as compared with his previous lighting account. Flour mills worked under better conditions than this, owing to the longer lighting hours. In most of these mills when a man put down a new engine he allowed some margin in power so that he could put down other machinery, and the effect of putting on additional loads was to bring the engine up to its more economical working load, and did not necessarily mean additional coal. A Leeds firm had two gas engines and two dynamos, one gas engine and dynamo working all day for power purposes. They had the other gas engine in use later in the day for lighting purposes. The amount of gas that passed through the meters for these two engines in one week was 43,250 cb. ft., which, at 2s. 3d. per 1,000 cb. ft., cost about £4 10s. The interest and depreciation on the two gas engines and dynamos taken at, say, 10 per cent. on cost, came to about £1 10s. for one week; attendance, oil, and maintenance came to £3, rather an extravagant figure, giving a total of £9 for the week. The amount of lighting used during this week, if charged at 4d. per unit, would have amounted to £24. With power from a power company at 2d. per unit, the total cost for power for the week would come to about £5. The total for power and lighting would thus be £29 per week, instead of £9 which was the cost with their own plant.

Mr. A. CAMPBELL, as a mechanical engineer and a user of electric power supplied by a power company, said that the figures given in the paper and also those of the dissentients from those figures struck him as being extreme figures in both cases, and he thought the truth lay in the average of the two. It was necessary to consider each case on its own base. In his own firm's case the substitution of motors for engines was done to meet increasing demands for power owing to extensions, and this gave them an opportunity to consolidate their works and shelve the whole question of generating at the works for a few years.

Mr. W. HARTNELL, in reply, said a very useful paper might be written on the advantages of purchasing electricity from a public company, but that was not the subject of this paper. In example 12 all the quantities were accurately measured. Mr. Dickinson had presumably based his load factor on the maximum lamps fixed. In most of these examples the dynamo must be overloaded to supply all the lamps. The cases he alluded to were apparently normal hours; the examples included dark days and overtime. When each lamp lighted added proportionately to the costs, the lamps lighted would be reduced to a minimum; but where the increased cost of extra lights was scarcely noticed, the lamps were lighted and allowed to glow without stint. In example 10 the oil used per set per 12 hours was 1½ gallons each at 1s. 6d. per gallon; £18 should have been £48. In example 12, if coal were taken at 6s. per ton, it would allow a minimum of over 4 lb. per kilowatt-hour. An electric lighting station running for hours on a very light load, with redundant plant to meet emergencies, and superfluous boilers under steam to be prepared for heavy surprise loads, could scarcely expect to obtain the same results as a plant which had a fairly constant load all day, where economy and efficiency had been studied both in planning and in working the plant to suit the known load. These were the circumstances in example 12. With regard to Mr. Woodhouse's remarks, the word "cost" was restricted to the *increment* of cost (or the addition to the previous total costs) which had been incurred by supplying electricity on the premises. This applied also to the assumed increase in the coal bills. This increase in Example 2 was estimated from experiments made at Thames Ditton. The units had not been estimated from the rated output of the dynamos. Experience had shown that in many cases the use of electricity increased, and that dynamos in private firms were often overloaded to the utmost they would bear. In reference to Mr. Rosling's remarks as to private plants, 4,500 units were the estimated output of the dynamo; not more than 3,000 units would be used, and the cost per unit would be about 10d. Presumably no household would install a private plant if a public supply were available. There was considerable difficulty in estimating the cost of maintaining a dynamo in good working order, since examples might be seen in the West Riding of dynamos that had run for years without any repairs, not even new brushes. This paper showed the minimum of cost per unit at which, under favourable circumstances, electricity could be supplied from private plants.

THE NEUTRAL MARKETS OF THE WORLD: THEIR OPPORTUNITIES.

V.—Paraguay and Uruguay.

(*a*) *Paraguay.*—Paraguay and Bolivia are peculiar among the South American Republics, in that they possess no seaboard, and are, consequently, dependent upon transhipment trade in the majority of their dealings with foreign countries. In this respect, however, Paraguay is in a far better position than Bolivia; for, in spite of her situation in the interior of the continent, she has cheaper communication with the sea by means of the great river systems of the Upper Parana and the Paraguay, which afford direct water transportation to the River Plate ports of Argentina and Uruguay. At present an Argentine company has a monopoly of the river trade, but the completion of the projected railway across Eastern Paraguay and the Southern States of Brazil to the Atlantic seaboard, which is only a question of time, should provide competition, and thereby reduce freights and offer better facilities.

The total area of the country is a little over 98,000 sq. miles, and the population is estimated at 700,000. Unfortunately, the growth of population has been almost too rapid, the institutions of the country having failed to keep pace with it. A better tendency is, however, being shown; the Government and people have been aroused to the importance of the speedy development of the country, with the result that liberal offers are being made to induce foreign capitalists to invest money in the undertakings of the country.

It is impossible to obtain any very reliable particulars as to the trade of Paraguay, partly because of the unreliability of the official figures and partly because practically all the trade is done by transhipment at Buenos Ayres or Monte Video. Semi-official statistics show that in 1904 the total imports amounted in value to about £700,000; imports from the United Kingdom were valued at about £220,000, from Germany about £170,000, and from the United States only about £25,000. The imports from the United States, however, are increasing very rapidly. The total imports have increased from £580,000 in 1901, and it is stated that this rate of increase was more than maintained in 1905. It is impossible to obtain satisfactory details as to the extent of the trade in particular classes of goods, but it may be stated that the majority of the imports consist of textiles, ironware and machinery. Although the imports from the United Kingdom are far in advance of those from any other country, she may have something to fear from the deep interest which American manufacturers are taking in the South American markets—an interest which extends to Paraguay, and which has been considerably encouraged by reports recently made with reference to that country by the special commissioner who was appointed a short time ago by the United States Government to inquire into the trade conditions of South America.

As has been stated above, the policy of the ruling classes is distinctly in favour of encouraging the investment of foreign capital in the country; valuable concessions are being given, with tax reductions and tariff exemptions, and efforts are being made to guarantee security to investors. New railway extensions are being made, and are proposed, concessions have been granted or are under consideration for the installation of electric tramway, lighting and power works in Asuncion and in some of the larger outlying towns. The country is altogether badly in want of capital and labour, and it is stated that with the advent of the former the latter will soon be available. With all this development in view, the requirements of the country in the near future will be very great, and with the spread of electrical enterprise which is anticipated in tramway, lighting and power works, and telegraph and telephone construction, there must necessarily be a particularly large demand for electrical materials. American manufacturers will not be behindhand; their goods are popular in South America, and they are not slow to see that investment of capital in industrial undertakings necessarily means increased trade. The most essential step that must be taken in opening up investment and trade is the sending to the country itself of expert agents or commissioners to operate directly. The employment of agents in Argentine or Uruguay to act also for Paraguay will not be sufficient to secure the best results.

As stated above, most of the trade is done *viâ* Buenos Ayres and Monte Video, and the buying agents in London of the large importing firms in these towns would doubtless be the best people to approach with a view to the introduction of electrical goods into Paraguay, in cases where it is impossible to send commercial travellers. The two following firms in Paraguay may, however, be noted as being interested in electrical undertakings:—The Empresa Telefonica, Asuncion; and Jose Cordeiro, Electricity Works, Villa Franco do Campo, Paraguay.

The following Customs duties are levied in Paraguay: Copper bars, plates or ingots, 2 per cent. *ad valorem*; porcelain goods, 40 per cent. *ad valorem*; telegraph wire, locomotives, machines and parts thereof for industrial or agricultural establishments and for steamships, wheels with or without axles for railways or tramways, &c., and rails of iron or steel, are all free of duty; all goods not separately mentioned in the tariff pay 35 per cent. *ad valorem*. The Customs law of November 18th, 1899, authorised an additional duty of 1 per cent. gold on the importation of all dutiable foreign goods, and the Customs law of July 14th, 1903, authorised an additional 3 per cent. duty in gold on the importation of dutiable goods. Moreover, a wharf duty of 1 cent. gold per 10 kilograms has been levied on all articles loaded or unloaded at any port. Duties are payable in gold (gold peso = 4s.) or in paper at the rate of exchange fixed daily. Valuations are fixed by the Customs authorities. It is stated that the valuations have recently been revised, and that the revision has considerably lessened the amount of duty payable.

Spanish is the language of the country, and catalogues should be prepared in that language. Local agents are stated to be of no avail; capable representatives should be sent, and samples or models are a great factor in securing orders. Commercial travellers, upon entering Asuncion, pay a tax of 400 to 600 pesos (£10 to £15). This payment does not, however, exempt them from a further tax on arrival in any of the country towns, although these towns do not always avail themselves of their right to levy taxes. Samples without value, and unserviceable for use, may be imported free of duty. Dutiable goods are allowed to pass the Customs on condition that an undertaking is made to pay the duty in the event of their not being re-shipped within a specified time (usually from one to two months).

Uruguay.—The development of the republic of Uruguay has been considerably hampered by constant revolutions which have occurred in the country, and these, whilst directly affecting the trade of the country for the time being, have also brought the republic into disrepute abroad, thus making merchants and manufacturers extremely wary of undertaking business relations with a country so frequently in a state of unrest. The last revolution occurred in 1904, and a decrease of £827,080 in the import figures was shown in consequence. The exports, on the other hand, showed an increase in spite of the disturbances. Since the revolution the productive and recuperative powers of the country have asserted themselves to a marvellous extent, and, given internal peace, it may safely be anticipated that the trade and condition of the country will show a steady improvement.

The imports in 1904 amounted to £4,514,190, as against £5,341,270 in 1903; the imports from the United Kingdom were valued at £502,581, from Germany £58,056, and from the United States £49,227; the imports from Italy, Spain and Portugal, and France amounted to about £100,000 in each case. The imports from all countries, with the exception of the United States, showed decreases. The exports in 1904 amounted to £8,182,163, as against £7,939,980 in 1903, and were chiefly to Brazil, Belgium, Germany and France. Figures showing the details of trade in separate classes are only available for 1903, and even then the classification is very poor, so that it is impossible to arrive at any satisfactory particulars as to the trade in electrical goods. The import of implements and tools for industries in that year amounted to 1,112,960 pesos, as against 997,950 pesos in 1902; the imports from the United Kingdom were valued at 256,755 pesos, an increase of 10,000 pesos; and the imports from Germany at 341,493 pesos, an increase of 50,000 pesos. The imports of machines for industries amounted to 168,858 pesos in 1903, as against 162,157 pesos in 1902. The imports from the United States in these two classes, although relatively small, are rapidly increasing.

In previous articles attention has constantly been drawn to the interest which is being taken in South American undertakings by American capitalists, and the details of trade which are available for Uruguay make it evident that in that country also Americans are determined not to be behind hand. It must, however, be admitted that the figures of the trade of Uruguay cannot be relied upon to show the exact nature of the trade, for the imports are credited, not to the country of their real origin, but rather to the country of consignment; moreover, the unrestfulness of the country in recent years makes it impossible to draw any definite conclusions. There is now every reason to believe that peace will continue in the country, and that marked improvements will be shown in its industrial and commercial conditions. At any rate, the Government have begun to see the necessity for carrying out public works which will conduce to the increase of trade and the development of industry. A loan of 3,000,000 pesos has recently been negotiated, to be expended in the construction of roads and bridges, and the Government intend to purchase the latest improved machinery for the work. It is proposed first to build a road from Monte Video through the centre of the Republic to Brazil. With this general improvement there should be a considerable opening for electrical enterprise in the way of railways, lighting, and telegraph and telephone works; and as sentiment is now in favour of American machines, British makers will have to keep a close watch on the requirements of the market in order to obtain their share of the trade.

The Union Industrial Uruguaya was established in Monte Video in 1898, for the purpose of improving the industrial condition of the country. The "Union" receives the support of the Government, a decree having been passed some time ago to the effect that the assistance of the "Union" should be required in case of necessity. A section for foreign industrial establishments has been established, and the "Union" is prepared to receive catalogues and small collections of samples for display. Catalogues accompanied by price lists with discounts allowed should be addressed to the Manager of the "Union," at 177 Calle Juncal, Monte Video. Every effort is made to place the catalogues before buyers in Uruguay.

Electrical enterprise is somewhat in its infancy in Uruguay, although several towns have either already installed electric light or are making arrangements for so doing. Concessions have been obtained by the Commercial Society of Monte Video for electric traction in the town, and over 80 miles of track have already been constructed for four of the tram companies. Electric trams will probably be running before the end of the year. The Municipal Electrical Works of Monte Video were established in 1885, with high-tension alternating current from seven 80-kw. Ganz alternators, two 360-kw. and one 400-kw. Helios alternators.

The following duties are payable on importation into Uruguay:—Bronze or copper wire 31 per cent., valuation 48 cents per kilog; sheet copper 31 per cent., valuation 50 cents per kilog; lanterns of